SCIHS

Sound Change in Interacting Human Systems
3rd Biennial Workshop on Sound Change
University of California, Berkeley, May 28-31, 2014

Welcome!

Increasingly, the study of sound change in language draws upon research in sociology, phonetics and phonology, and approaches in computer simulation of social interactions. Our aim is to include scholars from various fields of linguistics, many of whom have divergent research methods and foci. This is intended to train many eyes on fundamental problems in sound change and foster new directions for research.

This workshop is supported by the Department of Linguistics at UC Berkeley, and by a generous grant from the **National Science Foundation**. We are very grateful to our sponsors.

thanks for coming!

Keith Johnson, Andrew Garrett, and Larry Hyman

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Program

All sessions meet in the conference center at the Clark Kerr Campus of the University of California at Berkeley.

The workshop is open to the public; all are welcome. If you plan to attend, please let us know (soundchange@berkeley.edu) so we can plan accordingly. A fee must be paid to eat meals with the conference attendees in the Grand Court dining room (see the "Logistics" link).

Wednesday, May 28

3:00	**Check in**	
5:00	Reception	
6:30	Dinner	

Thursday, May 29

Morning session - Usage Factors (for abstracts see pp. 1-6)

8:30	Do grammatical factors impact sound change?	*Joan Bybee*
9:10	Explaining lexical frequency effects: a critique and an alternative account	*Márton Sóskuthy*
9:30	Lexical functional load predicts the direction of phoneme system change	*Andrew Wedel & Scott Jackson*
9:50	Break	
10:10	Typological and articulatory perspectives on context effects	*Jeff Mielke*
10:50	Hierarchical inference and lexical diffusion of sound change: How words and sound can change together.	*Vsevolod Kapatsinski*
11:10	Informativity licenses word-final lention	*Uriel Cohen Priva*
11:30	General Discussion	
Noon	Lunch	

Afternoon session - Social Factors (for abstracts see pp. 7-12)

1:30	The social motivation of sound change: recent developments	*William Labov*
2:10	Changing Individuals, changing language?	*Mary Kohn & Charlie Farrington*

2:30	Quantifying age-related and phonetic change in a longitudinal study	*Ulrich Reubold & Jonathan Harrington*
2:50	Break	
3:10	'Bring hither the fatted coo': Real-time change in Glaswegian over a century	*Jane Stuart-Smith*
3:50	Whose sound changes do we follow?	*Molly Babel, Grant McGuire & Jamie Russell*
4:10	Talk like a man: perceived masculinity	*Meg Cychosz*
4:30	General Discussion	
5:00	Poster Session 1	(for abstracts see pp. 13-28)
6:30	Dinner	

Friday, May 30

Morning session - Phonetic Factors (for abstracts see pp. 29-34)

8:30	Sound change propagation: the relation between perception and production in individual language users.	*Patrice Speeter Beddor and Andries W. Coetzee*
9:10	Probabilistic Enhancement and Australian English /æ/	*Felicity Cox & Sallyanne Palethorpe*
9:30	Non-nasal Nasals: Reinterpreting nasalisation in Shiwiar (Jivaroan)	*Martin Kohlberger*
9:50	Break	
10:10	Idiolectal phonology produces the pool of "phonetic" variation.	*Alan Yu*
10:50	Testing the listener-driven model of dissimilation	*Mary Stevens & Jonathan Harrington*
11:10	On the Coda Weakening of Rhotics in Brazilian Portuguese	*Iiris Rennicke & Thaïs Cristófaro Silva*
11:30	General Discussion	
Noon	Lunch	

Afternoon session - Typology (for abstracts see pp. 35-41)

1:30	Southeast Asian tonogenesis: how and why?	*Jan-Olof Svantesson*
2:10	The rise and fall of voiceless vowels across Finnic Varieties	*Natalia Kuznetsova & Daria Sidorkevitch*
2:30	Sound change in Australia: Current knowledge and research priorities	*Luisa Micelli & Erich Round*
2:50	Break	

3:10	Adoption, maintenance and loss of click contrasts	*Bonny Sands*
3:50	On a 'crazy rule' of Ancient Greek	*Adèle Jatteau*
4:10	Bantu Spirantization is a reflex of vowel spirantization	*Matt Faytak & John Merrill*
4:30	General Discussion	
5:00	Poster Session 2	(for abstracts see pp. 42-56)
6:30	Dinner	

Saturday, May 31

Morning session - Modeling (for abstracts see pp. 57-62)

8:30	Phonetic precursors and structural typology	*Elliot Moreton*
9:10	(Non-) Phonologization : Individual Variation in an Artificial Grammar Learning Task	*Rebecca Morley*
9:30	Learning biases in phonological typology	*Klaas Seinhorst*
9:50	Break	
10:10	Actuation without production bias	*James Kirby & Morgan Sonderegger*
10:50	Modelling sound change in relation to time-depth and geography: a case study on the Indo-European and Tupían language families.	*Gerd Carling, Sandra Cronhamm, Niklas Johansson, Filip Larsson & Joost van de Weijer*
11:10	A computer simulation of Franconian tonogenesis	*Paul Boersma*
11:30	General Discussion	
Noon	Lunch	

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Poster Session 1

(for abstracts see pp. 13-28)

Thursday afternoon

A hierarchical approach to variation and sound change	*Tatiana Korobeynikova*
The emergence of a register system from the word-initial voicing contrast in Japanese	*Mieko Takada, Eun Jong Kong, Kiyoko Yoneyama, Mary E. Beckman*
Vedic post-lexical retroflexion: synchronic and diachronic perspectives	*Chundra Cathcart*
Speaker- vs. Listener-based explanations for dispersion effects in sound change	*Tommy Denby, Grant McGuire, & Jaye Padgett*
Accounting for variation in Tamil retroflex articulation	*Sarah Bakst*
Non-faithful accommodation of coincident phonetic cues	*Jevon Heath*
A Case Study of the On-going Sound Changes in Singapore Mandarin	*Yuen Choo*
Fricative vowels as an intermediate stage of vowel apicalization	*Fang Hu & Feng Ling*
The addition of a uvular trill in two Basque dialects	*Oroitz Jauregi, Miren Lourdes Oñederra, Irantzu Epelde*
A New Look at Cassidy (1983)	*Hideo Kobayashi*
KWOD ERAT DEMONSTRANDUM: An empirically supported account of labiovelar historical developments	*Helena J Beeley*
Sound Change in Si-Xian Hakka Vowels: From the Comparison of Vowel Normalization Procedures	*Lai, Yi-hsiu*
Real-time change in onset /l/ over four decades of Glaswegian	*Rachel Macdonald & Jane Stuart-Smith*
Liquid Metathesis	*Daniela Müller*
The role of variation in retuning perceptual categories, and the role of gender in laboratory sound change	*Bridget J. Smith*

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Poster Session 2

(for abstracts see pp. 42-56)

Friday Afternoon

Confusion of tense and modality? Impact of L1 phonological transfer on verb semantics	*Sonja Dahlgren & Martti Leiwo*
Social variables facilitating subphonemic shift in Nigromante Zapotec	*Erin Donnelly*
Devoicing of /v/ in Dutch: linking perception and production	*Anne-France Pinget, René Kager, Hans Van de Velde*
Phonetically conditioned sound change: /u/-fronting in Souletin Basque	*Ander Egurtzegi*
When secondary cues take over: Phonetic changes and resulting phonetics-phonology mismatches	*Silke Hamann*
Shifting or Shifted? The state of California vowels	*Cory Holland*
Taiwan Min Checked Tones Change	*Ho-hsien Pan, Fang-Yi Jian, Chia-Jou Liu, and Hsiao-Tung Huang*
On the mechanics of tonogenesis: evidence from prevoicing	*James Kirby & D. Robert Ladd*
Sibilants in Italian/Tyrolean bilingual speakers	*Lorenzo Spreafico*
Extreme high frequency, segment deletion and chunking: a study of emerging inflected pronouns in Brazilian Portuguese	*Ricardo de Souza*
Usage of non-canonical forms in Colombian Spanish vowel sequences	*Marisol Garrido*
Biphonetic conditioning on Middle English /h/-dropping	*Toshihiro Oda*
Self organization in plural forms in Brazilian Portuguese	*Thaïs Cristófaro Silva, Clerton Barboza, and Katiene Nascimento*
Allophony as a response to lexical competition: Allophony correlates with high functional load of the conditioning context.	*Márton Sóskuthy & Andrew Wedel*
The indexical function of pre- and post-aspiration in a sound change in progress	*Hanna Ruch*

Do grammatical factors impact sound change?

Joan Bybee
University of New Mexico

The definition of sound change as phonetic change that is regular within a phonetic environment covers a vast number of known cases. A certain residue of changes that appear to be phonetically conditioned but that violate the definition in one way or another present a long standing, but very interesting problem. These include cases of 'lexical diffusion' in which a change does not go through to completion in the lexicon, sound changes that appear to be blocked in certain grammatical conditions, and phonetic changes that occur only in a certain word class, construction, morpheme or phrase.

The hypothesis of this presentation is that the phonetic environment is key, but the 'phonetic environment' must include cases where that environment itself is variable or alternates because of factors such as in the degree of stress (in discourse) and distributional probabilities by which some words occur in the favorable phonetic environment more than others. I will argue that the rate at which a word occurs in the phonetic context for the sound change is the primary factor in creating cases in which it appears that grammatical information may be influencing the phonetic change. An exemplar model with constantly updating representations provides a mechanism both for lexical diffusion and for apparent grammatical effects. This accords well with the Neogrammarians' idea of the mechanical nature of sound change, but expands the contextual factors that have to be taken into account.

Explaining lexical frequency effects: a critique and an alternative account

Márton Sóskuthy, University of York, marton.soskuthy@york.ac.uk

High-frequency words often lead phonetically natural changes. Pierrehumbert (2001) presents a usage-based explanation for this phenomenon, which is widely cited in discussions of frequency effects. I use computational simulations to show that – contrary to the claims in the literature – Pierrehumbert's model does not predict lexical frequency effects. I propose an alternative account based on mixture distributions (cf. Kirby 2010), which makes correct predictions with respect to frequency, and also explains why sound change is typically less affected by lexical factors than it is by the phonetic context.

Pierrehumbert (2001) suggests that sound categories have separate representations for each word they occur in. These representations consist of exemplars with different levels of memory activation. Production is based on existing exemplars, but it is also affected by phonetic biases such as coarticulation. The resulting productions are fed back into the speaker's exemplar store. Sound change occurs when the effects of a bias accumulate in category representations through this feedback loop. Pierrehumbert argues that the effects of biases accrue faster in the representations of frequent words, which explains positive frequency effects.

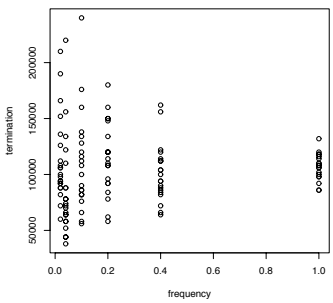
This claim has not been tested through simulations. Pierrehumbert's argument rests on interpolation from a different kind of simulation, which looks at the influence of the *overall* number of productions. To investigate the effect of *relative* frequency, I re-ran these simulations with words of different relative frequencies. A single word influenced by a phonetic bias was produced repeatedly until the mean of its representation reached the bias attractor. (1) plots the relative frequency of the word against the time it took to reach the bias attractor. The two variables are not correlated: that is, this model does not predict a frequency effect. This is because frequent words are more resistant to the effects of new exemplars than infrequent words (because their overall memory activation levels are higher). Even though high-frequency words are 'nudged' towards the bias attractor more often, they also take more 'nudges' to reach it.

The model described in this talk offers a different explanation for frequency effects. This model is similar to Pierrehumbert's in that it incorporates a feedback loop and word-specific representations, but the details of production are different. Production targets are generated by sampling a mixture distribution, which is a weighted sum of all word-specific representations for a given category. The weights of the word-specific distributions are proportionate to their frequencies. This ensures that infrequent words do not have an unduly large influence on production. Moreover, the distribution belonging to the target word is more heavily weighted than the rest of the distributions. This allows word-specific effects to emerge.

To test if this model can account for frequency effects, I generated 20 lexical items whose frequencies followed a Zipfian distribution. 10 of these contained a biasing environment. I then ran a simulation similar to the one presented above. (2) plots the evolution of the means of the 10 biased words. Frequent words (shown by darker lines) clearly lead the change (this is confirmed by a linear regression model). This is because the weighting of the mixture components allows more independence for words that are more frequent. In this model, frequency effects emerge not because frequent words are more often affected by biases, but because they are more autonomous in production.

This model can also explain why sound change is more strongly affected by the phonetic context than by word-specific patterns. The frequency of a phonetic context within a category is typically much higher than the frequency of a word. If production is co-determined by context and word-specific representations, the influence of the phonetic context will be relatively large: phonetic contexts have more independence in production than words (due to their higher frequency). (3) shows the evolution of two context-specific sub-distributions within a category (the model parameters are the same as above; the components now represent phonetic contexts). The size of this effect is larger than that of the frequency effect in (2).

(1)



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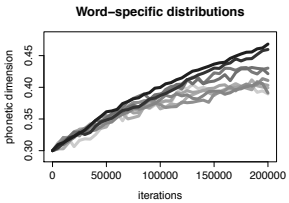

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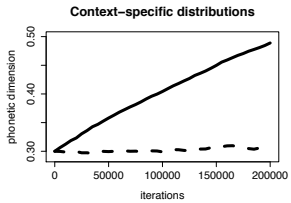

Lexical functional load predicts the direction of phoneme system change

Andrew Wedel (University of Arizona)
Scott Jackson (University of Maryland)

Since the early 20th century, it has been proposed that loss of a phonemic contrast due to language change should be less likely when that contrast does more "work" to convey meaning in the language (e.g., Gillieron 1918, Trubetzkoy 1939, Hockett 1967, Silverman 2010). Recently, Wedel et al. (2013) showed that a lexical measure of functional load, operationalized as the number of minimal pairs distinguished by a phonemic contrast, is an empirically predictive measure of phoneme merger probability within a crosslinguistic database. In the work presented here, we expand on this work by asking if the converse is true as well: does lexical functional load as measured by minimal pair count predict phonological changes that avoid lexical contrast loss?

Here, we examine two phenomena that are correlated with preservation of lexical contrast despite sound change: chain shifts and phoneme splits. Chain shifts are concerted movements of phoneme pairs within the same dimensional space (Labov 1994, Ch. 9, Gordon 2002). Phoneme splits are a merger of a contrast in one dimension or context accompanied by the generation of a new contrast in a different dimension or context (Labov 1994, Ch. 11). Shifts and splits have distinct effects on the phoneme inventory: in a shift, the mapping between phonetic space and the phoneme inventory changes, but the inventory stays the same. In a phoneme split, the phoneme inventory itself changes as well. However, shifts and splits have the same consequence for the lexicon: changes in the phonological system are compensated such that lexical distinctions are preserved.

As a further test of the general hypothesis that a bias toward maintenance of lexical distinctions plays a causal role in sound change, we obtained the within-word-category lexical minimal pair count for 695 phoneme pairs in nine different sound systems (American English, RP English, Dutch, German, French, Spanish, Hong Kong Cantonese, Korean, and Turkish), out of which 55 phoneme pairs are reported to have merged in some dialect of the language in recent diachronic history, and 28 have been reported to have participated in a shift or split. Counts of minimal pairs and other variables were collected from a standard corpus for each language. Linear Mixed Effects modeling indicates that the number of minimal pairs for phoneme pairs that have undergone a shift or split is significantly higher than those that have merged, or for which no change has been reported. Further, if we restrict our analysis to those phoneme pairs that have undergone some change within this dataset, the number of within-category minimal pairs distinguished by a phoneme contrast is sufficient alone to predict with high accuracy whether the change is a merger or shift/split. The striking value of minimal pair count in predicting whether a change preserves lexical distinctions provides support for the hypothesis that a bias toward lexical disambiguation influences the overall trajectory of sound change (e.g., Wedel 2012). Finally, the observation that shifts and splits behave similarly in this dataset with regard to minimal pair counts is consistent with models in which relationships between existing lexical items exerts influence on diachronic sound change (e.g., Wang 1969, Bybee 2002, Phillips 2006, Hume et al. (in press)) in addition to any influences at the level of the phoneme inventory itself.

Typological and articulatory perspectives on context effects

Jeff Mielke
North Carolina State University

One reason to study sound change is to better understand how speech production and perception map onto the typology of synchronic sound patterns. This talk explores the relationship in two ways: (1) by considering how sound change is reflected in a record of synchronic sound patterns and (2) through articulatory investigation of variation and change. The typological component is an analysis of P-base (Mielke 2008, Brohan and Mielke 2014) highlighting types of sound change that most clearly leave their mark in synchronic phonology (including consonant epenthesis and some other context-sensitive changes), and types of sound change that largely do not (most obviously, context-free shifts). The articulatory component focuses on the production of /æ/ in 20 English speakers from around North America. /æ/ tensing appears to be at a crossroads, being a context-sensitive allophonic pattern throughout much of North America while apparently also being the first step in the context-free Northern Cities vowel shift (Fasold 1969, Labov et al. 2005, etc). The articulatory study uses time-varying articulatory signals derived from ultrasound videos (Carignan and Mielke 2014) to reveal distinct articulatory trajectories in different /æ/ tensing environments and a potential link between context-free and context-sensitive versions of the pattern.

Hierarchical inference and lexical diffusion of sound change:
How words and sounds can change together

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Bybee (2001, 2002) identifies two word frequency effects in sound change. Reductive sound change is supposed to be due to repetition and begin in high-frequency words. As a result, Bybee predicts that the least reduced words should be the least frequent words. However, as Bybee also notes, high-frequency words are better able to resist analogical change due to imperfect acquisition of low-frequency lexical representations. For instance, low-frequency English verbs are regular, having succumbed to –ed, while many high-frequency verbs have retained their original past tense forms. Note that analogical pressure is also in effect for articulatorily-motivated sound changes, as long as the sound change is affecting instances of a particular phonological unit and there are distinct pre-change and post-change variants of the changing unit. This makes one wonder whether the prediction that reductive sound change should affect lowest-frequency words still holds once the simultaneous existence of analogical pressure in favor of the change is taken into account.

I implement the theory computationally in R and show that the theory actually predicts that reductive sound change should indeed affect high-frequency words first but once the change spreads sufficiently, low-frequency words are expected to fall in line, with some medium frequency words remaining exceptional.

In the developed model, reduction in a given instance of a word is simultaneously affected by 1) the overall tendency of the speaker or speakers we are studying to use the reduced variant in the phonological, syntactic and social context in question, 2) the frequency of the word in which the variable occurs (whenever a word is used, its probability of being reduced is incremented), and 3) the identity of the word: some words are reduced more or less than their frequency would predict (Bybee 2002, Pierrehumbert 2002). Every generation of speakers reduces words in proportion to their frequency of use in speech (Bybee 2001, 2002, Pierrehumbert 2001). However, in L1 learning, children do not explicitly try to recover the function relating word frequency to probability of reduction. Rather the task of the learner is simply to learn to pronounce words correctly. I assume that part of this process is to acquire a probabilistic grammar of reduction, which specifies how often one picks a particular variant of a sublexical phonological structure in various contexts. This grammar allows the learner to, among other things, pronounce unfamiliar words and to adapt pronunciation to social context (Pierrehumbert 2002).

On this theory, blame for the perceived acoustics of a phone is apportioned on the basis of hierarchical inference. Thus the learner estimates overall probability of the reduced variant (in a given context) and the effects of individual words on reduction. I show that, if this theory is correct, the frequency effect, monotonic in its online effect on production, should nonetheless be U-shaped in the lexicon once the change has spread far enough, with low-frequency words being pulled in to not deviate from the overall mean.

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Informativity licenses word-final lention

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What influences the cross-linguistic distribution of sound change? Word-final lenition and deletion processes affect different segments in different languages. American English deletes /t/ word-finally (Guy 1991, among others), several dialects of Spanish lenite or delete /s/ word-finally (Hochberg 1986, among others), and Indonesian lenites or deletes /k/ word-finally (Soderberg and Olson, 2008). Is it a coincidence that each of the three languages weakens a particular segment word-finally, a segment which is not weakened word-finally by the other two languages? I propose that the distribution of weakening processes is predictable from the relative informativity segments hold in different languages. I show that when the informativity of a particular segment is comparatively low, it attracts weakening processes. Thereby, relative low informativity licenses the actuation (in the Weinreich et al sense) of segment-specific sound-change processes.

Current models of sound change explain the articulatory, perceptual, and grammatical conditions that license sound change, and the mechanisms through which it spreads once actuated (Kiparsky, 1995; Pierrehumbert, 2001; Ohala, 2003, among others). But even if some sound change is phonetically plausible, current models do not predict which language is likely to be affected by which process. Recently several attempts used information theory to account for sound change (Hume, 2008; Wedel et al., 2013, among others). Cohen Priva (2008) showed that word-medial segment deletion rates are affected by segment informativity – the average or expected amount of information a segment holds in a given language. Does relative low informativity license language-specific weakening? I tested this hypothesis within American English using a corpus of spoken American English, and cross-linguistically by comparing the informativity of similar segments in languages with different weakening patterns. Both studies indicate that lower informativity promotes weakening.

In a controlled study I used the Buckeye Corpus (Pitt et al., 2007) to predict word-final deletion of all post-vocalic pre-consonantal American English obstruents while controlling for phonological features, rate of speech and word frequency, and using word identity as a random effect. Low informativity significantly predicts likelihood of word-final deletion in English ($p<0.001$). The contextual predictability of segments did not contribute to predicting word-final deletion, providing support to the *exceptionless* properties of sound change. High frequency words were more likely to be reduced, suggesting that information affects production at more than one level.

In a cross-linguistic study I compared the relative informativity of sounds among three languages in which /t/, /k/ or /s/ weaken word-finally: American English, Spanish and Indonesian. The prediction is that if in some language a segment weakens, its informativity would be lower than in languages in which it does not weaken. For American English, words were assumed to have their CMU pronunciation dictionary representation (Weide, R., 2008.) and word counts were taken from the Fisher, Switchboard and Buckeye corpora. For Spanish I used the CALLHOME Spanish Lexicon (Garrett et al., 1996) for both word counts and dictionary representation. Due to the absence of spoken corpora of Indonesian, the informativity of Indonesian was estimated using publicly available texts. Informativity of phonemes was estimated as the expected value of the negative log probability of a segment given every preceding segment in the same word. Indeed, the informativity of /t/ was lowest in American English, the informativity of /s/ was lowest in Spanish, and the informativity of /k/ was lowest in Indonesian, mirroring word-final weakening patterns. The probability of having that pattern emerge by chance is $(1/3)^3$, with $p<0.038$. This study therefore provides converging evidence that relative low informativity does lead to the actuation of sound change in specific languages.

Both studies show that when a segment's informativity in a given language is relatively low, that segment is more likely to weaken than in a language in which its informativity is high. By controlling for phonological factors in the first study, and by comparing identical segments in the second study, I could focus on the role of information in the actuation of sound change. The results suggest that higher information translates to stability, and low information translates to propensity to weaken.

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The social motivation of sound change: recent developments

William Labov
University of Pennsylvania

My first study of the social motivation of sound change focused on the centralization of /ay/ and /aw/ before voiceless finals among speakers with a positive orientation towards the island of Martha's Vineyard. But most sound changes are responses to other sound changes, as in the backing of /ʌ/ in New York State or the lowering of /ʌ/ in Pittsburgh. They proceed well below the level of social awareness, and affect the speech community in a uniform manner. If we trace the causal chain backwards in time, we frequently find a triggering event in population movements, as in the building of the Erie Canal or the mass migration of Slavic speakers into Pittsburgh. As a change progresses, it may develop social salience and recede under social correction, especially in formal styles, as in the monophthongization of /aw/ in Pittsburgh or the monophthongization of /ay/ in the South. The South is in fact alone among the major North American regions in the general recession of its dialect in the younger population. In the largest cities—Atlanta and Dallas—the inmigration of Northerners has obscured the basic Southern pattern. The most extreme example of the social correction of linguistic structure is found in Baranowski's study of Charleston where the ingliding long vowels in *say* and *go* are converted to upglides and the merger of *fear* and *fair* is uniformly reversed. This may be attributed to the leading position of the upper class in the wholesale conversion of the traditional dialect to a Midland form.

Recent developments in Philadelphia show the conversion of the phonemic split of tense and lax /æ/ to the allophonic nasal system in the college-oriented population. It remains to be seen if this new socially motivated direction will affect the phonology of the city as a whole.

Changing individuals, changing language?

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Does the social process of growing up influence linguistic systems in predictable ways? If so, do these cycles advance sound change? Current hypotheses based on synchronic data suggest that lifespan change in which individuals modify their speech during portions of their lives contributes to language change. Childhood and adolescence are considered central to this process, yet the field lacks the long-term longitudinal studies necessary to observe the extent to which individuals modify their speech across this period of their lives. This current analysis uses data from the Frank Porter Graham (FPG) database, a unique longitudinal study of 67 African American children in the Piedmont region of North Carolina, to identify whether adolescent speakers differ from their childhood selves, as predicted by Labovian models of adolescent sound change. Synchronic evidence suggests that adolescents use more advanced variables for sound change in progress than children or adults creating an "adolescent peak" (Labov 2001). Few sociolinguistic studies, longitudinal or synchronic, include child data; and, as such, this hypothesis remains empirically underexplored.

The current analysis focuses on a subsample of twenty individuals (ten females, ten males) from FPG at five time points from approximately age 4 to age 20. Over 20,000 vowels were extracted for analysis. In addition to recordings, a multiplex array of social and linguistic measures was included for analysis. We compare time points across the group by conducting mixed model regressions with individual growth curves, a technique commonly used for longitudinal data analysis in allied fields (Singer and Willett 2003). Subjects come from two demographically different communities in central North Carolina: Durham, a larger primarily African American city, and Chapel Hill, a small, historically European American, town that is eight miles southwest of Durham. The demographic differences in each location are also reflected in general linguistic patterns with Durham speakers exhibiting the largely stable southern AAE variety, while the Chapel Hill speakers are beginning to reflect the predominant urban southern shifted variety found in Raleigh, North Carolina (Dodsworth and Kohn 2012).

Initial analysis across four of the five time points shows that, at the group level, adolescents do not stand out as distinct from their childhood selves. However, this group stability masks individual variability. While some individuals have largely stable vowel systems across time points, the majority show a range of patterns of real-time change. These results challenge current understanding of the relationship between individual trajectories across real-time and synchronic community patterns of variation. However, the results do not eliminate the possibility that children progress sound changes as they develop into adolescence, particularly during vigorous sound changes.

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Quantifying age-related and phonetic change in a longitudinal study

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This longitudinal study investigates age-related as well as phonetic changes to formants in broadcasts by British-American speaker Alistair Cooke spanning 60 years in order to tease apart the two effects. The first formant frequency (F1) in voiced frames and in non-low vowels shows a falling-rising pattern with increasing age (Fig. 1a), and the fundamental frequency is highly correlated with F1 in high vowels. We argue that these similar shifts in f0 and F1 are likely to have a perceptual origin both because the distance between F1 and f0 is a perceptual cue to vowel height and because F1 tracks the changes that occur to f0 due to physiological age-related changes to the larynx. By contrast, there are also F1 changes in low vowels that differ from those of non-low vowels (Fig. 1a) and are most likely associated with physiological changes to the jaw opening mechanisms. Additionally, we find that F1 and F2 follow a similar pattern with increasing age in open back vowels in which these parameters are close together in frequency, which is also consistent with a perceptual explanation.

A second aim was to establish evidence for phonetic changes in adulthood. Our auditory impressions suggests to our surprise that Alistair Cooke's accent in the later part of his life was reverting from an acquired General American (GenAm) accent towards the one he spoke before he emigrated to the United States, Standard Southern British (SSB). The phonetic changes that we observe impressionistically include in particular a backing of vowels of the Standard Lexical Set BATH (e.g. *after*, *last*) and a raising and an increase in lip-rounding in the stressed vowels of LOT words (e.g. *doctor*) in Cooke's broadcasts between the ages of 60 and 70 years: both of these are characteristic differences between GenAm and SSB.

We quantified the changes to F1 and F2 in phonetically changing vowels, and used the log. Euclidean distance ratio to quantify the relative position of the changing vowels between two stable anchor vowels. The results of this acoustic analysis show that BATH moved from TRAP towards START (Fig. 1b), and LOT from START towards NORTH (Fig. 1c) supporting our impressions that Cooke's accent shifted from one characteristic of GenAm toward SSB. Yet, such an accent reversion is consistent with studies in other areas such as bilingualism that provide some limited evidence for accent (or first language) reversion later in life due to changes in social factors.

The relevance of this study for sound change studies is twofold: both in apparent-time and real-time studies, formant (and related) measurements must be treated with caution due to the confounding factor of age-related effects; secondly, adult speakers might accommodate to their community (and therefore also take part in communal change innovated by young community members), but also might not accommodate or even undo an accommodation depending on social factors.

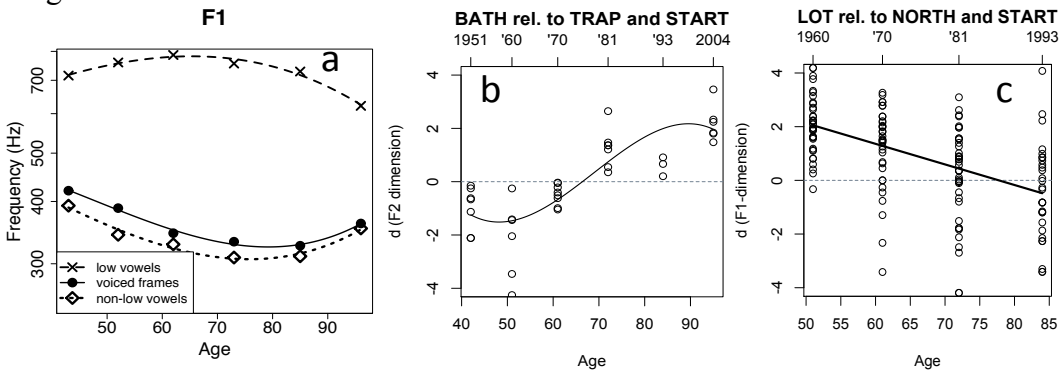

Figure 1 a: F1 ~ Age in voiced-frames (solid curve), low (dashed) and non-low (dotted) vowels.
b and **c:** log. Euclidean Distance ratios ~ Age for BATH (b) and LOT (c) tokens: positive/negative values denote positions closer to TRAP/START (b) or NORTH/START (c) respectively.

'Bring hither the fatted coo': Real-time change in Glaswegian over a century

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This paper considers the evidence for sound change in real and apparent-time by looking at the case of Glaswegian vernacular across the 20th century. The resources for the study consist of (1) the 'Sounds of the City' corpus, a real and apparent-time corpus of time-aligned, force-aligned, speech recorded from elderly, middle-aged and adolescent male and female speakers, in the 1970s, 1980s, 1990s, and 2000s and (2) short recordings of young men from Glasgow made in 1916 and 1917 in prisoner of war camps in Germany. Three aspects of the sound system will be examined: the fate of the stressed, tense vowels; the implementation of Scottish Vowel Length Rule; and the realization of /r/. The results will be discussed in the context of the speech samples themselves, our current conception of variation and change to these features, and social changes to the city since the turn of the 19th century.

Whose sound changes do we follow?

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Research on face perception using the minimal group paradigm (Tajfel et al., 1971) has shown that (face) perceivers have an own-group bias such that they are better at remembering faces from their own (randomly assigned and experimentally manipulated) ingroups (Young et al., 2012;Van Bavel & Cunningham, 2012). Given that the improved recall of faces has been linked to an increase in attention to own-group faces during the perceptual encoding process (Young et al., 2010), we propose that a similar effect is operative in speech perception which may have significant implications for our understanding of the transmission and diffusion of sound change. Specifically, we propose that sound changes spread faster through ingroups because listeners attend more to the phonetic substance of own-group voices.

We begin this line of inquiry by simply assessing whether voice memory is subject to group membership effects and voice typicality, closely following the established paradigms in the face processing literature. To this end we conducted two minimal group voice memory experiments. In Experiment 1 participants (n=30) were presented with a version of the Big 5 personality test (John & Srivastava, 1999), and were told that their score would determine whether they had a (randomly assigned) red or a green personality. Participants were then given colored bracelets to cue their group membership. A voice exposure task followed the personality test, presenting listeners with 20 voices, which were each labeled with red or green personalities. A surprise test block came after the exposure block: participants were presented with 40 voices sans personality color and asked whether the voice was old or new. Experiment 2 (n=10, data collection is ongoing) was identical to Experiment 1 with the exception that personality colors were presented at test in addition to being presented at exposure.

Mixed effects logit models were used to analyze the probability with which listeners correctly identified voices as new or old. Group membership (personality color as ingroup or outgroup), Voice Status (old or new), and the previously rated stereotypicality of the voices were entered as fixed effects. To simplify the interpretation of the results, separate models were computed for Experiment 1 and Experiment 2. In the absence of group membership prompting in the test block, Experiment 1 illustrates the results are highly influenced by voice typicality, as shown by a significant interaction of Voice Status and Voice Stereotypicality. As can be seen in Figure 1, listeners were more accurate at correctly identifying new voices as new when they were low in stereotypicality, while old voices were more accurately identified as old when they were highly stereotypical. In Experiment 2 where listeners were informed of the assigned group membership at test, the results showed significant interactions between Voice Status and Voice Stereotypicality (just as in Experiment 1) and Group Membership and Voice Stereoypicality; this latter interaction is show in Figure 2. This figure illustrates that listeners were more accurate with less stereotypical outgroup voices than the more stereotypical outgroup voices, but that stereotypicality has little effect on voice memory for ingroup voices. This suggests that ingroup membership has a homogenizing effect on ingroup voices – members of our own ingroups are perceived more standardly, regardless of the underlying vocal aesthetic.

Voice familiarity and group membership affect voice memory in complex ways. By demonstrating that listeners attend to and process ingroup voices differently compared to outgroup voices, our results speak to the preferential acquisition documented in young children with respect to gender (e.g. Perry et al. 2001), peer-group language varieties (Chambers 1992, Payne 1980, Trudgill 1981, Kerswill & Williams 2000), and any sociolinguistic changes that spread through communities. In these cases of preferential acquisition we see listeners and speakers modeling their speech patterns on select input, as opposed to an aggregate of all spoken language they have been exposed to. We discuss our results with respect to attested patterns of sound change diffusion.

Talk like a Man! Perceived Masculinity in L1 and L2 Spanish

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Among the many linguistic stereotypes that pervade contemporary society, few are as stigmatized and developed as the stereotype that homosexual men sound effeminate, that they sound like women. The investigation at hand is an attempt to further the fields of sociophonetics and language and sexuality through the analysis of this widespread linguistic stereotype. This pattern among homosexual men has been studied to varying degrees of empirical success in English (Gaudio 1994; Linville 1998; Rogers, Smyth, & Jacobs 2000; Levon 2006; Campbell-Kibler 2011) and Spanish (Mack 2010, 2011) and such studies have often concluded that homosexual men pattern differently phonetically than heterosexual men and that such differences are perceptible to listeners. Yet, these studies have proven limited in their methodological approach to the analysis of the perceived homosexual speech patterns. Such studies have employed traditional sociolinguistic variables of gender and sexuality as binary [+/-heterosexual], a classification that has limited participants' sexual identities and the subsequent results of the study. The use of such complex, changing social variables as gender and sexual orientation warrants further expansion in the field of sociophonetics and language and sexuality to analyze what phonetic variation and change, if any, exists between heterosexual and homosexual men and if such differences are perceivable to listeners. This study thus proposes a preliminary analysis of this issue via the perceived sexual orientation (PSO) of male speakers of Argentinean Spanish (N=6) by bilingual and near-native Spanish speakers (N=14). PSO is defined as the manner in which listeners perceive speech and how, via acoustic recordings, listeners subsequently assign sexual orientation and rate masculinity. This will be empirically addressed through an extensive background questionnaire evaluating speaker sexuality according to the Kinsey Scale (K=0-6) (Kinsey et al. 1948). Two phonetic variables associated with female speech in Buenos Aires Spanish will be analyzed: 1) *sheísmo*, the devoicing of the /dʃ/ to /ʃ/ (see 1), in such Spanish lexical contexts as *calle* and *vaya*, and 2) deletion of word-final /s/ [Ø] (see 2).

1. [dʃ]oke to [ʃ]ook
"joke" "shook"

2. lo[Ø] chico[Ø]
los chicos
"the boys"

Through acoustic manipulations of these variants from natural speech samples, this study will demonstrate whether the variants of the /s/ and /dʃ/ in Argentinean Spanish can indicate sexual orientation in PSO tests and how masculinity is rated by both L1 and L2 speakers of Spanish. This work will expand upon previous binary [+/- heterosexual] sexual orientation variables to a continuous, flexible variable and will contribute to the fields of sociophonetics, laboratory phonology, and language and sexuality.

A hierarchical approach to variation and sound change

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Change in progress often surfaces as variation at subphonemic or suballophonic level. Significant inter-speaker differences in patterns of variation within one community (e.g. across various age groups) may account for the course and mechanisms underlying ongoing sound change. This paper addresses a situation in the dialect of the village of Kaj in the Kirov Region (North East of European Russia). The dialect shows a dramatic split between speakers in terms of patterns of variation. While some speakers display an array of competing realizations of a given phoneme in the same position, others adhere to a one-to-one relationship between position and allophone. The analysis has revealed that the vowel system in question is undergoing a radical change in it, which shows how speakers are losing less salient phonological contrasts; resulting in phonemes merging.

. Phonemes	Reconstructed situation	Transitional idiolects	Innovative idiolects
*/e/	[h l^{j} **e**p] *xleb* 'bread'	[hl^{j}**e**p], [hl^{j}**i**p], [hl**ɛ**p]	[hl^{j}**ɛ**p] (occasionally [hl^{j}**i**p], [hl^{j}**e**p])
*/ɛ/	[d^{j} **ɛ**n^{j}] *den'* 'day'	[d^{j} **ɛ** n^{j}]. [d^{j} **e** n^{j}]	[d^{j} **ɛ** n^{j}] (occasionally[d^{j} **e** n^{j}].)

Fig. 1. *Phoneme merge in the dialect of Kaj*

The data reveals that phonological rules which shaped the sound system of Kaj in the past are being gradually replaced. While the original situation is available to us only through previous descriptions (e.g. Moškina 1999), the other two stages; the transitional and innovative ones form two different strata of the current dialect and are available for observation. Although the two systems may show similarities in the inventory of available choices (as in **Fig. 1**), radical differences are found in the frequency of these choices and in factors that condition them. Situations as in the dialect of Kaj are challenging both from a synchronic and a diachronic perspective. The following questions arise with respect to this: **1)** What are the factors that condition speaker's choices in a system where two or more competing variants are available? **2)** What are the mechanisms that underlie categorization processes? To address these questions the author proposes a model based on the hierarchy of conditions on variation. The data from 4 speakers of transitional idiolects and from 3 innovative speakers (elicited from approximately one hour of recording per speaker) have been analyzed. The analysis shows that where two or more alternative pronunciation variants are available, the vowel quality depends on 4 conditions: **1)** prominent/non-prominent of a word within a prosodic phrase; **2)** speaking style (read speech vs. spontaneous speech); **3)** consonantal environment (e.g. C^{j}VC or C^{j}VC^{j}) **4)** vowel duration. One example is a variation of stressed front vowels with respect to height in transitional idiolects which shows the following correlations: **1)** prominent positions favour open vowels e. g. [z^{j}d^{j}**ɛ**s^{j}] while non-prominent positions favour higher vowels, e.g. [z^{j}d^{j}**i**s^{j}] (*zdes´* 'here'); **2)** speaking style: [vm^{j}**é**s^{j}te] – read speech; [vm^{j}**í**s^{j}te] – spontaneous speech (*vmeste* 'together'); **3)** consonantal environment, e.g. C^{j}VC vs. C^{j}VC^{j}: [hl^{j}**ɛ**p];– C^{j}VC; *xleb* 'bread' [o hl^{j}**í**b^{j}e];– C^{j}VC^{j}; (*o xlebe* 'about bread'); **4)** vowel duration ([v^{j}**í**t^{j}er] the higher vowel falls below the average duration of allophone of the phoneme /ɛ/, [v^{j}**é**t^{j}er] – the lower vowel is above this value; (*véter* 'wind').Statistics for transitional idiolects reveal the relative magnitude of these factors. In the total of 673 individual realizations of 88 morphemes which allow variation in front stressed vowels the correlation between height and prosodic position holds in 71% of all instances (480 examples). In the residuary 193 examples the correlation between height and speaking style works in 71% of instances (137 examples). In the remaining 38 examples 63% show correlation with the consonantal context and the rest 14 examples (54%) show correlation with duration. In contrast to this, there are only 40 individual realizations of 8 morphemes which allow alternative choices in the innovative idiolects. In 82% of these instances (33 examples) we find a correlation with the position within a prosodic phrase. The residuary 18% (7 examples) correlate with the speaking style (though numbers do not allow to make any strong claims), and the rest two factors, context and duration, are ruled out. The analysis of our data shows that the vowel system is moving from a phonological position that allows alternative choices under different conditions of pronunciation to a system with a one-to-one relationship between the phonological position and the allophone. The hierarchical approach has allowed establishing the relative magnitude of factors conditioning variation in the transitional and innovative idiolects. The impact of these factors is being gradually diminished as younger speakers gradually generalize one pronunciation variant across a number of conditions, which reflects the trajectory of sound change.

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The emergence of a register system from the word-initial voicing contrast in Japanese

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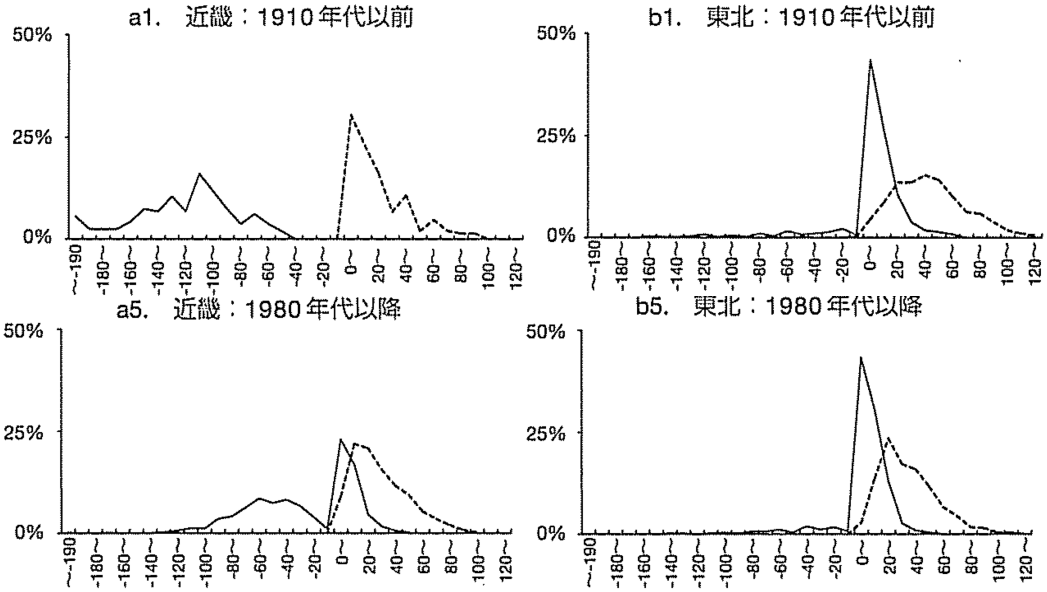
Japanese is usually described as contrasting voiced /b, d, g/ to voiceless /p, t, k/ word-initially and medially. In Old Japanese, however, the voiced stops are attested only medially, and initial /b, d, g/ developed later from the loss of initial vowels, as in (1), as well as from the influx of loanwords with voiced stops from Middle Chinese, as in (2).

(1) *i^{n}daku > [daku] 'embrace' (2) [budo:] 'grape' (cf. Shànghǎi [bu^{1}dɔ^{5}])

As (1) shows, the voiced stops in native forms are reconstructed as being prenasalized. The philological evidence for prenasalization is augmented by variation in transcribed reflexes of medial /b, d, g/ across modern dialects. Takada (2011) provides instrumental evidence that word-initial voiced stops also varied across modern dialects until recently, as illustrated in (3). Whereas panel a1 shows that older Kinki speakers contrast a voiced series (with a pronounced voicing lead) to a voiceless unaspirated series (lag VOT with a mode around 5 ms), panel b1 shows that older Tôhoku speakers contrast a 'de-voiced' series (mostly short lag values) with a mostly aspirated series (VOT lag with a mode around 50 ms). Panels a5 and b5 suggest further that sound changes are in progress such that both the "true" voicing contrast of the Kinki dialects and the lag VOT contrast of the Tôhoku dialects are converging toward a system where VOT no longer functions as the primary cue. Other data in Takada (2011) suggest that Tokyo speakers pattern like Kinki speakers, except that the sound change is further advanced, so that a historic voicing contrast seems to be being replaced by a "register" difference in the standard variety. In this paper, we will report data from several studies using Tokyo dialect speakers that offer further support for this interpretation of Takada's (2011) VOT data as evidence of the emergence of a register system in modern standard Japanese.



(3) VOT (ms) in word-initial voiced stops (solid lines) versus voiceless stops (dashed lines) in productions by Kinki speakers (left) versus Tôhoku speakers (right) who were born around 1910 (top) versus born around 1980 (bottom).

Vedic post-lexical retroflexion: synchronic and diachronic perspectives

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The Vedic "prosody of retroflexion," a regular, usually lexeme-internal (and in reality, non-prosodically-conditioned) process by which *n* → *ṇ* if *r* or *ṣ* precedes it and no coronal obstruent intervenes, is widely discussed in the literature (Allen 1951; Allen 1953:66-7; Collinge 1965). Less attention is paid to this phenomenon as it occurs across lexical boundaries (i.e., post-lexically, henceforth PLR). In the Ṛg and Atharva Vedas, PLR affects *naḥ* (1pl. pron. cltc.), *na* (neg. ptcl.), *nú* (emph. ptcl.), *ena-* (prox. dem. pron.), and other forms (Wackernagel and Debrunner 1905, vol. I, 191). Lexeme-internal retroflexion is exceptionless; however, PLR is a gradient phenomenon with variable operation. This paper investigates the synchronic and diachronic phonological conditions governing the operation of Vedic Sanskrit PLR.

I generated a corpus containing tokens of *n/ṇaḥ*, *n/ṇa*, *n/ṇú* and *en/ṇa-* extracted from the Ṛg and Atharva Vedas. For each token, the following crucial information was recorded (along with other relevant data): whether the preceding word contained a VIABLE TRIGGER OF RETROFLEXION (i.e., *r* or *ṣ*, with no following coronal obstruent); and whether this trigger was NON-ADJACENT or ADJACENT. Mixed-effects logistic regression showed that non-adjacent triggers served as a highly significant predictor of retroflexion (accounting for 82.2% of retroflex tokens, $\chi^2(8) = 80.7, p < .001$), while adjacent triggers did not ($17.8\%, \chi^2(8) = 2.9, p = .08$).

This finding is odd, given that cross-linguistically, post-lexical rules are common at word boundaries (e.g., *gree*[m b]*ox*); since Vedic retroflexion can be triggered at any distance, there seems to be no *a priori* reason that one process should be significantly better represented than the other. Another strange pattern emerges from the data: in certain contexts where a viable trigger is present, PLR is categorically blocked. For example, we see sequences like RV 4.55.10c *índro no* '[may] Indra NOM [come] to us', but never **índro ṇo*. It is easy enough to envision a post-lexical grammar where PLR is generally disfavored and blocked (respectively) by final *-r* and *-o*, but these constraints are not naturally motivated. Contexts in which viably triggered retroflexion is either under- or unrepresented involve the operation of sandhi rules at the word edge, e.g., /-as/ → *-o*, /-s/ → *-r* / $V_{[hi]}$_. However, in order to keep a traditional rule-ordered model from over-predicting PLR, it would be necessary for post-lexical rules to operate before lexical ones:

/indras# nas/ → (1. PLR) indras# nas (blocked) → (2. sandhi) indro# no

This presents yet another theoretical problem.

With sandhi rules in mind, I modified the corpus to take into account whether a viable trigger would have been present in the word preceding each token at an earlier historical stage; hence, a sequence like *indro no* (< **indraz naz*) lacks a HISTORICALLY VIABLE TRIGGER, with the coronal obstruent **z* blocking retroflexion, as does *agnir*, whose *r* is not etymological, but rather a surface variant of /s/ (whereas a form like *súvar* actually contains an etymological *r*). When we limit triggers to those that would have historically operated ($N = 613$), mixed-effects logistic regression shows that ADJACENT TRIGGERS are a highly significant predictor of retroflexion ($16.4\%, \chi^2(7) = 87.9, p < .001$) given that their distribution is no longer grossly overestimated (in reality, they make up .57% of the original corpus). The effect of NON-ADJACENT TRIGGERS continues to be highly significant, and there are no apparent structural gaps. And, far from having to posit two separate grammars for lexical and post-lexical phonology, it becomes clear that Vedic lexical and post-lexical retroflexion were originally parallel processes. Diachronic explanation is often invoked in the case of arbitrary or strange-looking synchronic alternations, usually within the domain of lexeme-internal phonology. In this study, I show how a diachronically sensitive factors improve a model of a post-lexical process, and that the fossilization of historical processes happens in the prosodic word as well as the lexical word; just as structural gaps and exceptions to rules can arise lexeme-internally, similar patterns in certain domains of the prosodic word can be due to residue from a earlier diachronic stage.

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Speaker- vs. Listener-based Explanations for Dispersion Effects in Sound Change

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Phonetic dispersion—defined as the maintenance of sufficient pyschoacoustic distance between phonemic categories such that they remain distinct—has been proposed as the driving force behind universal trends within phoneme inventories and a number of closely related sound-change phenomena, such as vowel chain shifts and compensatory sound change. While the need to appeal to dispersion in sound change seems clear, the precise mechanism by which it comes about has remained elusive. The results of our experiments, testing both speaker-based and listener-based mechanisms, are reviewed here.

Speaker-based accounts (e.g. Liljencrants and Lindblom, 1972; Lindblom, 1986) posit that speakers are sensitive to the communicative needs of listeners, and adjust their production based on these needs. There is strong evidence to support a broad version of this claim, given that speakers hyperarticulate vowel productions when prompted for "clear" speech in a laboratory setting (e.g. Moon and Lindblom 1994; Uchanski, 2005) and can tailor their speech for various settings. Yet these types of global effects do not account for the hyperarticulation of individual phonemes to preserve a particular contrast, and thus do not explain dispersion effects such as chain shifts. Further, they can actually be explained by appeal to a listener-based approach (McGuire et al. 2010).

The listener-based hypothesis, (Labov, 1994: 587; Wedel, 2006; Denby, 2013), posits that phonetically unambiguous productions will influence future productions of the listener more than ambiguous productions. The mechanism that drives this is a filter: not all ambiguous productions are stored to phonetic memory (or are stored but decay faster than their unambiguous counterparts). In turn, these unstored productions do not update the phonemic categories of the listener, and are not reflected in that listener's future productions. The filter acts as a buffer between phonemic categories, reducing the number of productions stored between phonemic categories relative to those at the center of the distribution.

The first set of experiments sought to test the speaker-based account by examining subjects' online control over dispersion of individual vowels. Subjects were visually prompted to pronounce monosyllabic words containing one of three adjacent vowel categories, e.g., [ɪ,ɛ,æ]. Subjects were told they were testing speech recognition software. For some trials the presentation software (E-prime) appeared to incorrectly recognize the production and prompted further (hopefully hyperarticulated) productions, with up to three additional repetitions possible. The productions of interest to us involve the middle in the vowel triplet, e.g., [ɛ]: in one condition, subjects were led to think the program misheard [ɪ] (e.g. reporting recognizing "pick" instead of "peck"); in another the program "misheard" [æ]. The hypothesis was that productions of [ɛ] in the former conditions would be lower than those in the latter. The results of these experiments, under various conditions, have been null, giving no support so far for the speaker-based approach to dispersion.
In an experiment designed to test the listener-based approach, subjects heard ambiguous target words and unambiguous control words in noise and were asked to identify them, following Goldinger (1996).

Subjects were exposed to a word list containing minimal pairs, each of which was monosyllabic and stop-initial, differing only in first-segment voicing (e.g. *tip*/*dip*). Half of these pairs were normal, unambiguous productions, while the stop-initial VOT of the other half were manipulated to be somewhat ambiguous by replacing periods of the onset of the vowel of the voiced member with aspiration from the voiceless member. An ambiguous stimulus skewed towards a voiced initial stop, and one skewed towards voiceless, were created for each minimal pair. After each stimulus, subjects typed the word they heard using a keyboard.

If subjects store these words, their accuracy should improve with every exposure. If however, they do not store ambiguous productions, their accuracy should not improve after repeated exposures, or improve less than it does for unambiguous productions. Using *d'* scores, a repeated-measures ANOVA (subjects treated as random effects, with experimental block and stimulus ambiguity as factors) reported that differences in improvement between ambiguous and unambiguous stimuli are significant (Subject*Ambiguity, $F(1,24)$, $p < .0005$; Subject*Block*Ambiguity, $F(3,72)$, $p < .05$). Results also indicated, however, that the manipulation of the stimuli was flawed, as subjects had a large bias towards hearing ambiguous stimuli, regardless of intended voicing, as voiced, and that this may represent a serious confound. Nevertheless, this provides strong initial evidence for a listener-based approach. Currently, a follow-up study is being implemented to further test and expand these results.

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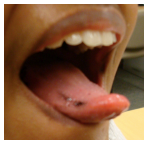
Accounting for variation in Tamil retroflex articulation

This study presents palatographic evidence of an articulatory change in progress in Tamil retroflexes. X-ray evidence in Ladefoged & Bhasksararao (1983) showed that while speakers of North Indian Indic languages (Hindi, Punjabi, Guajarati) tend to make apical retroflexes just behind the alveolar ridge, many speakers of South Indian Dravidian languages (Tamil, Malayalam) tend to make palatal retroflexes with the sublaminal region of the tongue. Although Tamil is a Dravidian language, this study shows that some speakers make their retroflex stops and laterals in the more anterior style of Indic languages (Figure 1). The linguagrams of fronted retroflex stops come from three speakers of which one gives additional lateral data.

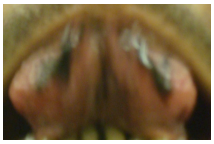
This articulatory change follows a change in the phonemic inventory of Tamil. An earlier stage of the language contrasted three coronal stops: retroflex, alveolar, and dental. The alveolar stops merged with the tap, leaving only a retroflex/dental contrast in the stop system. While the change in inventory alone could be responsible for the fronting of the retroflexes, it is also possible that the asymmetrical language contact situation in India also contributed to the articulatory change. While it is often required for speakers of Dravidian languages to learn Hindi in school, it is far less typical for speakers of Indic languages to learn Dravidian languages. The result is that speakers of Dravidian languages speak Hindi with Northerners, whose articulations may have influenced all retroflex articulations of Tamil speakers. Without the pressure of keeping alveolars distinct from retroflexes, the latter category can be fronted.

Phonologically, the change can be explained as the loss of a featural contrast. In the three-way coronal contrast, retroflex and dental segments are specified [+ laminal], which contrasts with the [- laminal] of the alveolar. With the loss of alveolar stops, the laminal feature became superfluous for distinguishing retroflex and dental stops. The stops lost the specification for laminality and now contrast only for anteriority, allowing the change from a laminal to an apical stop.

(a) Anterior retroflex stop



(b) Anterior retroflex lateral



(c) Retracted retroflex stop

(d) Retracted retroflex lateral

Figure 1: Linguagrams from a Tamil speaker who has a more anterior retroflex (a, b) and one who maintains the more retracted retroflex (c, d).

Non-faithful accommodation of coincident phonetic cues

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The initiation of sound change requires the emergence of new variants. One possible source of new variants is non-faithful transference of linguistic features during accommodation to an interlocutor's speech. If the subphonemic cues associated with a phonological contrast are realized differently in an accommodating speaker's speech than in the signal to which they are accommodating, the resulting difference in phonetic realization may constitute a new variation. For example, English speakers are known to modulate the VOT of voiceless stops in phonetic accommodation (Fowler et al. 2003). This study examines the degree of automaticity in accommodation in three cues associated with VOT – duration of closure of the stop in question, as well as both the initial F0 and total duration of the vowel following the stop – when only the VOT is experimentally manipulated. To the extent that populations of individuals evince varying degrees of non-faithful transference of these coincident cues, this study provides evidence for a potential solution to the actuation problem (Weinreich et al. 1968).

The experiment consisted of an initial questionnaire, followed by a pre-task baseline recording, an imitation task, and a post-task recording. Subjects read aloud a randomized list of words in a pre-task baseline recording, then repeated recordings of words presented one at a time. Target words consisted of English words with a single stressed syllable beginning with a voiceless stop. The VOT of the pre-stress voiceless stops in these words was artificially doubled; no other adjustment was made to the stimuli. The procedure for the post-task recording was the same as for the pre-task recording. The questionnaire included demographic information as well as a Big Five personality test (Saucier 1994).

Shorter stop closure duration has been shown to be a cue for perception of voiceless stops in English (Boucher 2002), but has not previously been demonstrated to show accommodation effects. Preliminary data indicate that subjects showed significant increases to VOT ($p < 0.0001$), and significant decreases to stop closure duration ($p < 0.0005$), with no significant change to overall stop duration. Vowel duration has been shown to be susceptible to accommodation effects (Giles et al. 1991), but also varies systematically with speech rate (Boucher 2002). Vowel duration also increased significantly across conditions ($p < 0.005$), and correlated significantly with VOT ($p < 0.0001$). Initial vowel F0 has been shown to undergo accommodation effects (Delvaux & Soquet 2007), but in the context of VOT has been argued to be a learned association, rather than an automatic physiological consequence (Kingston & Diehl 1994). Vowel onset F0 increased significantly across conditions ($p < 0.01$), but did not correlate significantly with VOT ($p = 0.0519$). This suggests that subjects accommodated to the model speaker's higher vowel onset F0 independently of its status as a correlated cue of VOT. This lack of correlation suggests that F0 is a learned cue to VOT rather than an automatic one.

Differences in the degree of adjustment of correlated cues may reflect differences in the weighting of these cues in individual speakers' phonological representations. These differences may also provide an additional dimension along which the makeup of populations will differ, thus addressing the actuation problem in another way.

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A Case Study of the On-going Sound Changes in Singapore Mandarin

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This paper is a study of the on-going sound changes in Singapore Mandarin. For instance, the shift of unaspirated consonant to its aspirated counterpart. There are two cases: (1) the shift of unaspirated retroflex affricate [tʂ] to its aspirated counterpart [tʂ'], which is found particularly in an isolated phoneme [tʂuaŋ]. Precisely, the insertion of aspiration to the retroflex affricate [tʂ] exclusively occurs in the morpheme [tʂuaŋ^{51}]撞, which means 'collide/ strike'. (2) The shift of unaspirated stops to its aspirated counterparts, which occurs particularly in the following morphemes: 搭[ta^{55}] > [t'a$^{53\sim51}$]/ [t'aʔ], 遍[pian^{51}] > [p'ian^{51}], 编[pian^{55}] > [p'ian^{55}] and 焙[pei^{51}] > [p'ei^{35}]. Such changes are irregular as they only occur in particular morphemes, however, they do suggest motivations behind a linguistic evolution. Moreover, these sound changes demonstrate an interface between morphology and phonetics. And, it raises the long-standing question in the study of sound change: What role do lexical and morphological factors play in sound change?

In our cases, the shift of unaspirated stops to its aspirated counterparts in the morphemes 搭[ta^{55}] > [t'a$^{53\sim51}$]/ [t'aʔ], 遍[pian^{51}] > [p'ian^{51}], 编[pian^{55}] > [p'ian^{55}] and 焙[pei^{51}] > [p'ei^{35}] illustrate analogical change, which might due to imperfect learning. On the other hand, the shift of unaspirated retroflex affricate [tʂ] to its aspirated counterpart [tʂ'] in the morpheme [tʂuaŋ^{51}]撞 seems to illustrate a lexically or morphologically conditioned sound change. The rationale is that the same sound, which carries other meanings such as 壮 'strong', 状'shape', etc., did not undergo such a change. We hypothesize that the motivation, which triggers this sound change, is iconicity, precisely, sound symbolism.

Seemingly, sound symbolism involves analogical effects, i.e. the analogical association of certain phonemes and clusters with certain meanings. Thus, one may argue that the sound change '[tʂ] > [tʂ']' in Singapore Mandarin is still an analogical conditioned change. Nonetheless, when we contrast this change with another change in Singapore Mandarin, which is the removal of aspiration from the voiceless bilabial, i.e. [p'] > [p] that concerns an isolated morpheme 坡[p'o^{55}] 'slope', we can be sure of the dependency of the morpheme on the aspiration to convey meaning in the variation between [tʂ] and [tʂ'], since the removal of aspiration from [p'] in the morpheme 坡[p'o^{55}] 'slope' didn't cause any changes in meaning.

In summary, aspiration plays a crucial role in the sound changes discussed in this paper. In the variation between [tʂ] and [tʂ'], the morpheme conveys meaning via the aspiration whereas in the variations between the aspirated and unaspirated stops, there is no dependency of the morpheme on the aspiration to convey meaning. The dependency of the morpheme on the aspiration to convey meaning or not is realized in the articulatory program as an aspirated and unaspirated onset. Thus, a preliminary proposition- we agree that analogical effects can be discerned before a phonetic innovation, however, there are also cases where lexical and morphological factors be dominant. Furthermore, a contribution to the study of Singapore Mandarin- besides language contact and interference, Singapore Mandarin can possibly undergo internal variations and evolutions that are triggered by some objective rules such as iconicity.

Keywords: sound change Singapore Mandarin lexical/ morphological effects analogy

Fricative vowels as an intermediate stage of vowel apicalization

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Apical vowels are widely distributed in Chinese dialects (Karlgren, 1915-26), whereas fricative vowels or strident vowels are less known in Chinese dialects (Hu, 2007; Ling, 2011) as well as in other languages (Ladefoged and Maddieson, 1990). This paper is an acoustic and articulatory study of fricative vowels in the Suzhou dialect of Wu Chinese, and further argues that acquiring frication is an intermediate stage of vowel apicalization.

The acoustic study was based on 20 speakers, 10 male and 10 female. And four of them, 2 male and 2 female, also participated in the palatographic and linguagraphic study. Three additional male speakers participated in the electromagnetic articulographic study (EMA, the Carstens AG500 system).

The production of fricative vowels in Suzhou is characterized by visible turbulent frication from the spectrograms, and a significantly lower harmonics-to-noise ratio vis-à-vis the plain counterpart. The formant data show that the fricative [i] and [y] have a comparatively greater F1 and smaller F2 and F3 values than their plain counterparts. In the acoustic F1/F2 plain, the fricative vowels are located in a position between their plain counterparts and apical counterparts [ɿ ʮ]. Linguographic data reveal that more laminal part of the tongue is involved in the production of the fricative [i], as compared with the plain [i], which is basically anterodorsal. And the EMA study confirms a comparatively advanced lingual configuration in the production of the fricative vowels vis-à-vis their plain counterpart.

Diphthongization and apicalization are two commonly detected phonetic and/or phonological processes for the development of high vowels (Hu, 2007, 2013), with the process of apicalization being of particular importance to the phonology of Chinese dialects. Acquiring frication initiates the sound change. However, our data suggest that spectral characteristics of fricative vowels or apical vowels play a more important role in defining the vowel contrasts. In other words, plain high vowels, fricative high vowels, and apical vowels distinguish in place of articulation, namely being anterodorsal, laminal, and apical respectively; and frication becomes a concomitant and redundant feature in the production of fricative or apical vowels.

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The addition of a uvular trill in two Basque dialects

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In language contact situations it is very common to have the less prestigious language being influenced by the most prestigious one, but the contrary is also attested (Heine & Kuteva 2005). Basque is considered a 'vulnerable' language (Moseley 2010), one that lives in a diglossic situation with respect to two of the world's most powerful languages; Spanish and French. Nowadays, all Basque speakers are bilingual with either French or Spanish, and this language contact situation makes Basque very prone to borrowings from these two languages.

The case of phonetic features is of a special relevance in externally-induced variation and change phenomena, given that it is widely assumed that, in cases of language contact, phonetic features are amongst the easiest ones to borrow (Silva-Corvalán 2001). In this paper, we will focus on the addition of a uvular trill in two Basque dialects from the French area (Labourdin and Low Navarrese), as for most Lapurdian and Low Navarrese speakers the trill has acquired a uvular articulation (as in French), in contrast to the alveolar trill which can be found in the rest of dialects.

In our data, the addition of this unit appeared to be associated with differences in age. We will focus on three age groups: youngs (-30), middle-aged (40-60) and octogenarians (+80) from the traditional provinces of Lapurdi and Low Navarre (France). All of the informants (60) have the Basque language as their mother tongue and home language, but the older ones received education only in French and use it in formal (and often informal) situations, in oral and in written communication. The data come from recorded interviews —individual as well as in-group— held in Basque, and from specific questionnaires and word lists used in our project *Norantz: contact des langues et variation linguistique. Création d'un observatoire des nouveaux parlers basques*. A sample of data is analysed perceptually and acoustically with the Praat speech analysing program in order to study the alveolar or the uvular condition of each unit.

Language variation can mark stable class differences or stable sex differences in communities, but it can also indicate instability and change. When it marks change, the primary social correlate is age (Chambers 2002), and the change reveals itself prototypically in a pattern whereby some minor variant in the speech of the oldest generation occurs with greater frequency in the middle generation and with still greater frequency in the youngest generation. If the incoming variant truly represents a linguistic change (Labov 1994, Trudgill 1974), as opposed to an ephemeral innovation as for some slang expressions or an age-graded change, it will be marked by increasing frequency down the age scale, as it occurs with the youngest generation in this community.

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A New Look at Cassidy (1983)

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This study investigates whether Americans differentiate RSL (r-sound lengthening) as in *crrrash!* from SEE (schwa epenthesis for emphasis) as in *carash!*, and also in which situations each of these emphatic forms is used.

From May to July 2012, the author conducted one-on-one interviews with 14 Americans to determine if there is a difference between RSL and SEE. A major finding from this is that the respondents who adopt RSL and SEE as emphatic tactics are aware of the differences in use. This helps the author reach a testable hypothesis about the research question. It seems that RSL helps raise the degree of emphasis of the target situation in life-threatening events that concern the speaker and/or the addressee, whereas SEE is not used for that purpose because SEE gives a disrespectable impression to the addressee. Instead, SEE usually applies to raising the degree of seriousness of the target situation that concerns topics other than life-threatening events. From July to October 2013, the author carried out an anonymous survey with 81 Americans to see whether or not this hypothesis is correct. The results varied idiolectally and dialectally.

Based on this hypothesis about these two forms of emphasis, the author asked the same 14 Americans to recite the B part of carrier sentences three times without emphasis, and then emphatically with the same intonation pattern, rate of speech, and degree of stress. The subjects were instructed to choose either RSL or SEE as an emphatic tactic in each of the carrier sentences. The results were that for the carrier sentences like (1), all of the speakers adopted RSL in the target words for emphasis. This is assumed to be because inserting a schwa in the CC cluster gives a disrespectable impression to the addressee. (The author is Japanese and acted as the addressee in the experiment.) Therefore, this experiment supports the research hypothesis, especially when the carrier sentence addresses real life events, such as a tsunami. (The tsunami referred to in (1) meant the giant tsunami that occurred in Japan on March 11, 2011.) By contrast, for the carrier sentences like (2), all of the speakers adopted SEE as an emphatic tactic in order to highlight the degree of the target situation.

Carrier sentences

(1). A: Did you see the tsunami on TV?
B: Yeah, the giant tsunami was *crashing* the shore.

(2). A: Are you a bungee jumper?
B: Yeah, it's a *crazy* sport.

This study has an original finding that the use of RSL and SEE depends on the social context in American English. This finding was never documented in past studies.

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KWOD ERAT DEMONSTRANDUM
An empirically supported account of labiovelar historical developments

Research into the role of auditory misperception in sound change has proved increasingly fruitful in historical linguistics, as more and more linguists turn to laboratory techniques to establish a linguistic framework for sound change and provide explanations for cross-linguistic historical and contemporary phenomena. The role of individual speakers' perception and production in sound change is widely debated, and this paper will contribute to the scholarship in this field while providing new, empirically supported interpretations of one of the most widely-studied languages in the western world: ancient Greek.

Labiovelars demonstrate a cross-linguistic tendency to develop into labial stops; the phenomenon is well-attested within the Indo-European language family (e.g. ancient Greek, Osco-Umbrian, and Celtic) and in other, unrelated language groups (e.g. Uto-Aztecan, Muskogean, Utian, and, arguably, Proto-Oceanic). In ancient Greek, the Indo-European labiovelars developed into labial stops when preceding back vowels (e.g. **kʷotero-* > *potero-*, 'whether', and **gʷous* > *bous*, 'cow'), but into coronal stops before close front vowels (e.g. **kʷis* > *tis*, rel. pronoun). There is a cross-linguistic tendency for labiovelars to lose their labiality in the vicinity of a back and/or rounded vowel, occasionally resulting in rounding of the adjacent vowel (e.g. IE **gʷou-kʷol-* > Gk. *boukol-* 'goatherd'; Proto-Oceanic **kʷarawa* > Malasanga *kuro* 'shark'). The role of auditory perceptual "confusions", or reanalyses by listeners, in these sound changes has been discussed but not yet fully addressed.

I shall present the results of an experiment designed to reveal the most frequent auditory perceptual confusions relevant to sound changes involving labiovelars, labials and coronal stops. Subjects heard isolated, monosyllabic English words from sets which contrast in their initial phonemes (/kʷ, p, t, k/) and in their vocalic nuclei (/e, o, i/); the stimuli were mixed with background conversational noise to provoke misperception. The results provide no evidence in support of an acoustic-perceptual motivation for changes of labiovelar to labial obstruents or for changes of labiovelars to coronals. There is, however, convincing evidence in favour of an acoustic-perceptual bias for labiovelar developments towards velars adjacent to back vowels.

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Sound Change in Si-Xian Hakka Vowels: From the Comparison of Vowel Normalization Procedures

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This paper addressed the issues of acoustic normalization of Si-Xian Hakka vowels and of normalization procedures. An acoustic study of Si-Xian Hakka vowels, produced by native speakers in Mainland China and in Taiwan, was conducted. Twenty native speakers from Mei-Xian, Mainland China and thirty from Taiwan participated in the current study. Due to the geographical reasons, speakers from Taiwan were further divided into two subgroups: fourteen participants in Miao-Li (in the northern part of Taiwan) and sixteen participants in Mei-Nong (in the southern part of Taiwan). It was historically recorded that native speakers in these three areas spoke the same dialect of Hakka, that is, Si-Xian Hakka. Mei-Xian Hakka in Mainland China was regarded as the source region, where Miao-Li Hakka and Mei-Nong Hakka in Taiwan were originated. These participants were invited to read a wordlist of Hakka with six vowels embedded in different contexts (i.e. in different tones, in different phrase positions). Acoustic cues of F0, F1, F2, and F3 were automatically fetched. Nine normalization procedures, including five vowel-intrinsic procedures (i.e., HZ, LOG, BARK, MEL, and S&G) and four vowel-extrinsic procedures (i.e., LOBANOV, NEAREY1, NEAREY2, and GERSTMAN), were applied to these acoustic measurements. Discriminant analysis was conducted to examine and compare these procedures. Discussions were made on how effectively these procedures preserved phonemic information (i.e., six vowels), how they preserved the sociolinguistic information (i.e., the talker's regional background), and how they minimized physiological variation (i.e., gender difference). Results demonstrated that vowel-extrinsic procedures performed better than the vowel-intrinsic ones and that formant-intrinsic procedures performed better than the formant-extrinsic ones. Based on the discussion on these normalization procedures of Si-Xian Hakka vowels, implications for relevant linguistic issues and suggestions for future research were provided.

Key words: acoustics, normalization procedures, Si-Xian Hakka vowels

Real-time change in onset /l/ over four decades of Glaswegian

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The recent history of English has witnessed substantial changes to liquids, particularly rhotics in coda position, where variants often also carry social meanings for speakers. Much less attention has been paid to liquids in onset position. In many varieties of British English, the lateral /l/ tends to be realised as clear [l] in syllable onsets and dark [ɫ] in syllable codas (e.g. Recasens & Espinosa, 2005; Carter & Local, 2007). In contrast, it is generally accepted that Scottish English /l/, with the exception of some regional varieties, is dark in all positions (e.g. Johnston, 1997). Recent work has suggested that L-darkness may be best considered as being on a continuum from strongly dark to very clear rather than as a binary distinction (e.g. Recasens & Espinosa, 2005).

At the same time, the realisation of /l/ has been shown to be amenable to sociophonetic variation and change. It is well documented that coda /l/ is undergoing vocalisation towards a high back (un)rounded vowel in many varieties of English (e.g. Wells, 1982, Horvath and Horvath 2001; Dodsworth et al 2006). This change has also been identified in working-class speakers in Glasgow (e.g. Macafee, 1983; Stuart-Smith et al, 2006; Stuart-Smith et al, 2013). Less is known, however, about how degree of darkness may vary in onset /l/ in Glaswegian as a result of social identity and/or sound change over time. Stuart-Smith, Timmins and Alam (2011) found that the onset /l/ produced by Glasgow Asians is clearer than the /l/ produced by Glasgow non-Asians due to the influence of their other language (Punjabi), but that this /l/ was still relatively dark when compared to other accents of English. In addition, Macafee (1983) and Braber and Butterfint (2008) note that whilst /l/ can be velarised in all positions, middle class Glaswegian speakers may use clear /l/ where it occurs in RP, such as in syllable onsets.

This paper examines how onset (in this case word-initial) /l/ varies across elderly (aged 67-90) male and female working-class Glaswegians recorded in the 1970s, 1980s, 1990s, and 2000s. The data are from the analysis of a real-time corpus of Glaswegian speech which contains recordings from a variety of sources such as sociolinguistic and oral history interviews. Glasgow has experienced substantial socio-spatial changes over the course of the 20th century, and this sample approximately captures language acquisition in the 1890s, 1900s, 1910s and 1920s, together with subsequent lifespan changes. The main acoustic indicator of darkness in /l/ is generally taken to be F2 frequency, with darker /l/ having a lower F2 and clearer /l/ having a higher F2 frequency (see, e.g., Recasens & Espinosa, 2005). The present work consists of an acoustic analysis of the F2 of word-initial /l/ carried out following Carter and Local (2007), which segments the lateral and following vowel into four temporal phases: transition into the lateral; the steady phase of the lateral; transition out of the lateral; and vocalic portion. F2 values from the midpoint of the steady phase and average F2 values across the steady phase are reported.

Our analyses to date, based upon around 35 word initial /l/ tokens from eight females (two from each decade) and four males (one from each decade) show that, across phonetic contexts, Glaswegian word-initial /l/ is becoming darker over time, and in a different manner for males and females (the final corpus will comprise at least 24 speakers). Males and females who were born in the 1890s and 1900s, and males who born in the 1910s appear to produce a clearer word-initial /l/ than males who were born in the 1920s and females who were born in the 1910s and 1920s, with the difference between the two groups of females being particularly marked. We discuss these results in terms of potential for personal mobility during both wars and social changes in the city of Glasgow over the 20th century (cf Stuart-Smith, Timmins & Tweedie, 2007).

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Liquid Metathesis

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Introduction Liquid metathesis is a sound change in which a liquid seems to move to another position within the linear sound sequence, cf. the Occitan variant "crompar" of the verb "comprar" ('to buy') or Low German "bölken" vs. High German "blöken" ('to bleat'). A perception experiment was conducted to clarify some of the general tendencies of liquid metathesis.

Research questions and results In 115 out of 864 trials (= 13.3 %), participants' responses could be classified as liquid metathesis.

(a) Do some syllable positions favour liquid metathesis more than others? The type of syllable position in which a liquid occurs significantly influences its likelihood undergoing metathesis ($\chi^2 = 33.24$, df = 2, $p < 0.0001$). Liquids in complex coda clusters yield to metathesis most often, followed by those in complex onset clusters, and finally by intervocalic liquids.

(b) Are laterals and alveolar taps equally prone to metathesis? Laterals and rhotic taps do not differ in their tendency to undergo metathesis ($\chi^2 = 1.26$, df = 1, $p = 0.2614$).

(c) Does metathesis move the liquid into the same type of syllable position (e. g. from a complex onset cluster into a complex onset cluster in a different syllable), and if not, is there a preferred syllable position type for the outcome of liquid metathesis? Only liquids in a complex onset cluster have a significantly greater likelihood of moving into another complex onset cluster than into another syllable position type ($\chi^2 = 20.15$, df = 2, $p < 0.0001$). Numerically, however, this observation is also true for complex coda clusters and the intervocalic position.

(d) Does metathesis operate preferably syllable-internally, and if not, how far does a liquid move? Metathesis moved the liquid with overwhelming frequency into an adjacent syllable (in 90 out of 115 cases (= 78.3 %)) ($\chi^2 = 176.58$, df = 3, $p < 0.0001$). The liquid remained within the same syllable in only 7 cases (= 6.1 %).

Discussion Rhotic metathesis has previously been explained with reference to the presence of the svarabhakti vocoid which accompanies the alveolar tap in consonant clusters (e. g. Czaplicki, 2013). The fact that laterals are affected to an equal extent, however, questions the idea that the svarabhakti vocoid is the principal factor in a perceptual explanation of liquid metathesis.

The preference for metathesis to move a liquid into an adjacent syllable opens up new questions about the role of prosodic constituents grouping syllables below the level of the word, inside which the sound change may operate.

The role of variation and gender in retuning perceptual categories

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Exposure to phonetic variation can cause temporary and long-term retuning of perceptual categories, and it is hypothesized that this may be one of the underlying mechanisms of sound change. In selective adaptation (e.g., Eimas & Corbit 1973), repeated exposure to a speech sound reduces the range of potential targets that are categorized as that sound, thus narrowing the category. In perceptual adjustment (e.g., Norris, McQueen & Cutler 2003), repeated exposure to an ambiguous speech sound results in a shift in the phoneme boundary, thus increasing the acceptability of potential targets in the acoustic space between two sounds. A third form of perceptual re-tuning, which I will call "perceptual broadening," occurs when exposure to broad variation in a speech sound expands the boundaries of that sound category to include a greater number of potential targets (as hypothesized in Kleinschmidt & Jaeger 2012). This concept could explain the loss of non-native contrasts during early language acquisition, as well as more temporary re-tuning in an experimental paradigm.

Three experiments designed to recreate sound change in the laboratory also demonstrated effects of perceptual broadening. The first experiment showed broadening of the /v/ category among trained participants, who heard 3 repetitions of 80 different tokens containing word-initial /v/, relative to participants who did not receive training. Behavioral and eye-tracking measurements showed greater endorsement of /f/ and /b/ tokens as instances of /v/ for trained participants. The second and third experiments were designed to elicit a perceptual split of /t/ before /w/ (towards a front variant, /ʦ/, and a retracted variant /ʧ/), depending on the gender of the talker. Participants who heard only a single variant during training displayed perceptual adjustment, in which the boundaries of the /t/ category (before /w/ as well as before /u/) shifted in the direction of the training variant, and more tokens of that type of variant were acceptable as instances of /t/ than for untrained participants. But participants who heard male voices using the front variant (ʦ), and female voices using the retracted variant (ʧ), showed increased acceptance of /ʦ/ spoken by men, but not by women. They also accepted more /ʧ/ tokens as instances of /t/ for female talkers, relative to the untrained group, but also accepted more/ʧ/ tokens for male talkers. Participants who were trained with women using /ʦ/, and men using /ʧ/displayed overall perceptual broadening, in which the /t/ category expanded to accept both variants spoken by talkers of either gender as instances of /t/. It is hypothesized that because the men's retracted productions had the lowest frequency spectral average, and women's front productions had the highest, the range of variation was greater in this scenario than when the distribution of variants was reversed. The greater range of variation caused perceptual broadening for participants in this condition. When the distribution of variants was along socially expected lines (male retracted, female front), gender may have been disregarded as a relevant factor in adapting to the new pattern, but when the distribution was unexpected (male front, female retracted), the least expected variant (/ts/) was sorted according to gender.

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Sound change propagation: the relation between perception and production in individual language users

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Speech perception is dynamic and variable: perception evolves in real time and different listeners assign different weights to the unfolding acoustic properties. That the dynamic, variable nature of speech perception likely contributes to sound change has long been recognized. However, for perception to contribute to *sound* change, listeners' percepts must be publicly manifested.

This talk assesses the hypothesis that language users who heavily weight a particular phonetic property in perception manifest those perceptual weights in their productions. That is, we evaluate whether innovative (or conservative) perceivers are also innovative (or conservative) producers. We first review selected studies from the existing literature on the perception-production relation within individuals and argue that the emerging picture is decidedly complex. We then turn to our own work on this relation. In a study of a change-in-progress involving stop devoicing in Afrikaans, we compared Afrikaans-speaking participants' production of voicing and vocalic f0 for phonological voiced and voiceless stops (/b/ vs. /p/ and /d/ vs. /t/) against the same participants' perceptual use of these cues in stop identification. Those data show the predicted perception-production correlation: the more a participant uses voicing to perceptually differentiate stops, the more that individual produces voiced (as opposed to devoiced) variants. Time permitting, we will also discuss our ongoing study of American English-speaking participants' perceptual use of vowel nasalization to anticipate an upcoming nasal consonant and these participants' production of CVNC sequences.

Probabilistic Enhancement and Australian English /æ/

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Kirby's (2013) Probabilistic Enhancement Hypothesis (PEH) proposes that enhancement (emphasis of phonetic features to increase contrast precision) is an adaptive strategy to ensure perceptibility of phonemic contrasts. PEH hinges on three key concepts: *bias* (phonetic asymmetries [see Garrett & Johnson 2013] which may reduce the integrity of a contrast), *precision* (the accuracy with which a contrast can be perceived), and *redundancy* (the range of variously weighted phonetic cues specific to the contrast). The raising of [æ̃] which is a sound change in progress in Australian English (AusE) allows us to test the predictions of PEH. Our hypotheses are as follows:

- Phonetic *bias* will give rise to synchronic variation because the addition of nasal resonance has been shown to affect the (perceived) phonetic height of [æ̃].
- [æ̃] raising may lead to potential reduction of *precision* between [æ̃] and [ẽ], e.g. *pan* vs. *pen*.
- *Redundant* features (e.g. duration) may be selectively deployed to maintain contrast.
- Crucially, a relationship will be established between the *extent* of precision loss and the *degree* of redundant feature enhancement.

30 female AusE speakers (18-30 years) read /CVn/ and /CVd/ words (where C was /b, d/ and V was /æ, e/) in isolated and sentence contexts five times in random order. Sentences included the forced contrast construction: 'They don't say *X*, they say *Y*'. Where X and Y were either /CVn/ or /CVd/ words (e.g. 'They don't say BEN, they say BAN'). Each word was elicited in both X and Y positions. Duration, F1 and F2 were extracted for /æ/ and /e/ from the 2nd to 4th repetitions using standard techniques. Multilevel modelling (with speaker as random factor) was used in the analyses.

Analysis 1: F1, F2 and duration in isolated words were separately analysed to compare the factors nasality and vowel type. [æ̃] was significantly higher, fronter and longer than [æ] ($p<.0001$) and there was extreme variation in F1 and F2 of [æ̃] indicating predicted *synchronic variability*. To make sense of this variability, we used kmeans clustering based on the difference between F1 of [æ̃] and [æ] to identify speaker groups: 7 speakers were extreme nasal raisers, 16 were moderate raisers and 7 were non-raisers. Extreme [æ̃] raising could potentially reduce *contrast precision* with [ẽ].

Analysis 2: F1, F2 and duration were separately analysed to compare [æ̃] and [ẽ] in the extreme raiser group. No difference was found for F1, supporting loss of contrast precision. However, contrast was preserved by duration ($p<.0001$) (i.e. *redundant feature*). To determine if this effect could be considered enhancement, we examined the relationship between F1 and duration.

Analysis 3: Significant negative correlations between F1 and duration of [æ̃] in the isolated word context were found for the combined raiser and non-raiser group (*ban:* $r(40)= -.395$, $p<.01$, *dan:* $r(40)= -.379$, $p<.013$). The higher the nasalised allophone the longer it is, suggesting contrast enhancement. Duration appears to be reassigned as the primary cue to resolve potential conflict.

Analysis 4: To further test the hypothesis that increased duration for raised [æ̃] is an enhancement strategy, we compared the forced contrast sentence data for the two groups. Our prediction that reduced spectral contrast (i.e. raisers) would lead to increased duration was supported. Compared to the non-raiser group, the raisers had significantly longer [æ̃] (*ban*: $p<.003$, *dan:* $p<.0001$) and crucially showed a greater length *difference* between [ẽ] and [æ̃] (*ban*: $p<.025$, *dan:* $p<.001$).

Taken together, these results support PEH by showing that redundant cues (i.e. duration) can be redeployed and enhanced according to the degree to which contrast precision is compromised.

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Non-nasal Nasals: Reinterpreting nasalisation in Shiwiar (Jivaroan)

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Shiwiar is a so far undocumented Jivaroan language spoken by around 1,000 people in Ecuadorean Amazon. Shiwiar has 13 consonants in its phoneme inventory, as well as 12 vowel phonemes. There are four contrastive vowel qualities (/i ɨ u a/) which each have three contrastive variants: voiced oral, voiced nasal, and voiceless.

In addition to being contrastive on a lexical level, nasalisation in Shiwiar is used as a grammatical marker (ie. certain grammatical operations are conveyed purely by nasalisation). As nasalisation is used for both lexical and grammatical contrasts in Shiwiar, one might expect that it is in the interest of speakers to articulate nasalisation clearly and saliently to avoid misunderstandings. Surprisingly however, some speakers of Shiwiar do not nasalise vowels consistently in canonically nasal environments, and some do not nasalise vowels at all. Nevertheless, listeners have no trouble in understanding these speakers, suggesting that phonetic nasalisation is not the only cue to phonemic nasalisation in Shiwiar vowels. This implies that (some) speakers are exploiting one or a number of secondary cues to nasalisation which can be readily perceived by listeners.

In order to determine how different speakers produce nasalisation in Shiwiar, a production experiment was performed. Speakers were asked to do a picture elicitation task. All vowel qualities were tested in phonemically oral and nasal conditions. Three acoustic measures were taken from each test vowel: degree of nasalisation, vowel duration and formant frequencies.

Preliminary results show that there are indeed two strategies used by Shiwiar speakers to convey nasalisation. Some Shiwiar speakers canonically nasalise phonemically nasal vowels. In this case the velum is raised and the nasal cavity is coupled to the vocal tract, thereby raising the formant frequencies (as found in the previous literature). For these speakers, there is no significant duration difference between nasal and oral vowels. Interestingly, the second strategy involves no velum raising (ie. no canonical nasalisation). However, for these speakers, phonemically nasal vowels still had raised formants *and* had a longer duration than phonemically oral vowels. These findings confirm that phonemic nasalisation in Shiwiar can be conveyed by cues that do not involve phonetic nasalisation. Secondly, and perhaps more importantly, they show that non-nasalising speakers are exploiting a cue (namely duration) which is *not* found in the signal of nasalising speakers. Previous research has shown that there is a perceptual link between nasalisation and duration. It is therefore possible that the non-nasalising speakers *perceived* nasalised vowels to be longer and consequently started making use of duration in their production of those vowels, even though that cue was absent in the original nasal stimuli.

In this talk, the relevance of these findings for sound change will be discussed. It will be argued that the case of Shiwiar is a change in progress in which some speakers have started to reinterpret the phonemic contrast of nasalisation as a contrast in vowel quality and duration due to perceptual properties of nasalisation.

Idiolectal phonology produces the pool of "phonetic" variation

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Theories of sound change hypothesized that mistakes in speech perception and production, if uncorrected, may lead to eventual changes in perceptual and production norms. In this talk, I articulate a theory of sound change where systematic individual variation in speech perception and production takes center stage. To illustrate this theory, I focus on the origins of allophony, which are often attributed to effects of coarticulation. Such contextual effects in speech have been argued to be phonological in nature, given that coarticulation appears to be language-specific and planned. In this talk, I argue further for the phonological nature of coarticulation, using findings from recent behavioral and neurophysiological studies. In particular, I argue that the systematic variability across individuals in how coarticulated speech is produced and perceived suggests that individuals acquire different phonological grammars of coarticulation. Such differences, which are anchored to specific individuals, serve as the pool of systematic variation that members of a speech community may draw from to construct local identities.

Testing the listener-driven model of dissimilation

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This study investigates dissimilation, whereby one of two similar sounds changes to become less similar e.g. /kw…kw/ in Latin QUINQUE 'five' > Italian [tʃiŋkwe] (N.B. /k/ > /tʃ/ is a separate sound change). The most complete and widely accepted phonetic model of dissimilation is that of Ohala (e.g. 1981). Ohala argues that listeners use reconstructive rules to normalize for the effects of context on speech segments; dissimilation has its roots in the inappropriate application of these rules. E.g. a listener hears [kwinkwe] correctly but assumes labialization during the initial /kw/ is due to anticipatory lip-rounding for the second /kw/. In an error of cognitive processing the listener undoes labialization from the first /kw/ and stores [kinkwe] in their cognitive representation. The results of the only experimental study to test Ohala's model of dissimilation (Abrego-Collier 2013) do not support its predictions. In fact listeners gave more "r" responses when ambiguous [r]/[l] tokens were followed by /r/ than by /d/ (i.e. perceptual assimilation). This paper tests whether dissimilation is listener driven. We inserted an 11-step [kw-k] continuum into various contexts to test the effect of following segment (/kw/ or /s/); we also test prosodic context (accented v. unaccented) and segment adjacency (adjacent v. non-adjacent to /kw/). In a 2AFC perception experiment, 15 native Italian listeners were asked to decide whether phrases of type (a) and (b) contained *canto* 'I sing' or *quanto* 'how much' (eventually also *lacca* 'nail varnish' v. *l'acqua* 'the water').

(a) *ho detto* [kw – k]*anto quattro volte* 'I said how many/I sing four times'

(b) *ho detto* [kw – k]*anto sette volte* 'I said how many/I sing seven times'

Our main prediction is that there should be more "k" responses for (a) where the following word begins with /kw/. A linear mixed-effects model with Perceptual Category Boundary as the dependent variable, one of Following Word (*quattro, sette*), Accent (accented/deaccented) or Adjacency (to following word: *lacca-l'acqua* v. non-adjacent *quanto-canto*) as the fixed factor, and Listener as a random factor showed that neither Following Word nor Accent significantly affected the /kw – k/ decision boundary, but it was significantly affected by Adjacency ($\chi 2[1] = 12.34$, $p < 0.001$), with more "kw" for the *l'acqua-lacca* continuum. Results for our main hypothesis do not support listener-driven dissimilation; this prevents any conclusions about the effect of prosody and segment adjacency on dissimilatory errors. We attribute results to our methodology: we did not synthesize long-distance coarticulation (but are doing so in a follow-up experiment).

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On the Coda Weakening of Rhotics in Brazilian Portuguese

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This paper investigates sound changes involving rhotics in syllable final position in Brazilian Portuguese (BP). Like other Iberian Romance languages, BP has two rhotics, weak-r (alveolar tap) and strong-R (mainly back fricatives), that contrast intervocalically. However, unlike other Iberian Romance languages, BP may present not only the weak-r in syllable coda, but also strong-R and other rhotic sounds, and this variation will be the focus of this paper. Assuming the theoretical perspectives of Exemplar Models (Johnson 1997; Pierrehumbert 2001; Foulkes and Docherty 2006) and Complex Adaptive Systems (Ellis and Larsen-Freeman 2006; Bybee 2010) we will show that sound changes involving rhotics in BP codas are better understood in terms of general pathways of sound change that operate in the language, namely the tendency to segment weakening in codas and unstressed syllables. We will address the following questions: 1) Why does coda position present weakening? 2) What is the end result in the coda weakening of rhotics?

The results to be presented come from data collected in the city of Lavras, Southern Minas Gerais, from 14 subjects (7 women, 7 men) through a sentence completion task yielding 753 tokens for acoustic analysis. Answering question 1, we suggest that coda weakening follows from a tendency in BP to weaken segmental material in unstressed positions. Furthermore, the gestural configurations in coda are less synchronous than in onset position, which may contribute towards lenition in coda (Bybee (2001: 87).

Regarding the second question we posited, we found that in word-medial codas and word-final codas a wide range of segments is observed. Except for the final rhotic that manifests primarily as a tap when followed by a vowel, the other coda environments present great variability ranging from approximants to back fricatives and deletion. We suggest that coda weakening involving rhotics reflects a general tendency in BP to reduce the gestural magnitude in codas, leading towards the deletion of coda rhotics and, consequently, to open syllables. This pathway can also be observed, for instance, in the deletion of nasal consonants in coda and nasalization of the preceding vowel, and in the vocalization of coda laterals. Thus, coda variation reflects the instability of the system with respect to consonants in coda, and an emerging pattern of lexical items ending in vowels.

There is considerable inter-speaker variation in the data that will also be addressed. We suggest that an exemplar-based approach to phonetic variation could explain idiolectal variation related to sociolinguistic phenomena, as well as the perception of articulatorily and acoustically diverse rhotic variants.

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Southeast Asian tonogenesis: how and why?

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Abstract

In this talk I will deal with Southeast Asian tonogenesis from a phonological rather than a phonetic point of view. The focus will be on tonogenesis (and tone split) due to merger of voiceless and voiced onset consonants, and I will try to find out what consequences this has for the phonological analysis of the languages that undergo this sound change. I will argue that this kind of tonogenesis as such does not change the phonological structure of the languages undergoing it, but changes only the phonetic realizations of those features of the onset consonants that triggered tonogenesis. After the tone system has been established, however, the tones tend to undergo changes that can no longer be explained by these consonantal features. Data from Mon-Khmer languages will be used, in particular Kammu spoken in Laos, where some dialects have undergone this kind of tonogenesis but others have not, but also from other languages. In Kammu there is ample evidence that the tones, although phonetically realized on the syllable rhyme, is phonologically a feature of the onset consonants.

This kind of tonogenesis (and tone split) is an areal phenomenon of East and Southeast Asia and I will also deal with some languages that have developed tones in other ways, including languages of the Angkuic group of Mon-Khmer, some of which have developed tones from vowel length; I will speculate a bit about why this took place.

I will also try to put this into a larger perspective and see tonogenesis as part of a general areal trend to pack a greater part of the amount of information in a syllable into the vowel kernel. In addition to tonogenesis, processes that have this consequence include loss of onset clusters, which has taken place in several languges of the area, and also loss of word-final vowels making disyllabic words monosyllabic, which has taken place in Mongolian, a language spoken at the opposite edge of this area from the Mon-Khmer languages.

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The rise and fall of voiceless vowels across Finnic varieties

To date, no languages are known where a phonological contrast of voiced and voiceless vowels is incontrovertibly established, though it might exist in a handful of languages (Jakobson, Waugh 1987: 138–139; Ladefoged, Maddieson 1996: 315; Gordon 1998; Blevins 2004: 199–201). Voiceless vowels are typically very short and are usually ultimately lost, a fact that partly explains their typological rarity (Blevins 2004: 199).

The vowel inventories of Finnic languages have not been previously famous for containing voiceless vowels. However, our recent field research has proven their existence in at least two Finnic varieties of Russia: the Lower Luga dialect of the Ingrian language in the vicinity of St. Petersburg and a mixed Ingrian/Finnish dialect of Western Siberia. Both dialects are severely endangered, each with less than 100 speakers remaining. They are also very much understudied, especially the Siberian variety. The latter is spoken by an ethnic group whose ancestors were expelled to the Omsk region of Western Siberia in 1803-1804 from exactly the area where the former variety has been traditionally spoken along with the local Ingrian Finnish dialects. At present, there is a unique opportunity to compare these extremely closely related dialects that have existed separately since 1804.

While early research by Mägiste (1925: 82, 85) and Ariste (1965, 1969: 173) mentions voiceless vowels in Lower Luga Ingrian, they have been now attested in the Siberian variety for the first time. Our research has also found that these two varieties present two successive stages of evolution of voiceless vowels. On the basis of other closely related Finnic varieties, we can also trace their point of emergence (in Ingrian Finnish, Votic or Soikkola Ingrian dialects), as well as the point of their ultimate loss (in Estonian). We have thus a rare chance to attest in living languages and describe in detail all the stages of the rise and fall of Finnic voiceless vowels. The authors have been conducting fieldwork on all the above-mentioned languages since early 2000s. The paper will present the structural phonological modeling of this evolutionary chain. Moreover, the experimental phonetic data, as well as the data on how speakers themselves perceive voiceless vowels will be used. The perception data are based both on interviews with the speakers and folk manuscripts composed by two speakers of Lower Luga Ingrian.

Finnic voiceless vowels have originally emerged out of the non-initial short vowels in certain positions. The opposition of the non-initial lengthened vs. short vowels has transformed in the course of reduction into the contrast of short vs. reduced voiceless vowels. In Soikkola Ingrian, Ingrian Finnish and Votic, we observe different stages of this reduction process, with voiceless vowels occasionally occurring as allophones of original short vowels. For example (the most frequent allophones are in bold), [ˌkuk:o ~ˌkuk:**o̥** ~ ˌkuk:o̥] ‘rooster:NOM’ vs. [ˌkuk:**o**˙ ~ ˌkuk:o] ‘rooster:PART/ILL’. However, in these varieties, voiced reduced allophones are the most frequent ones, and they hardly ever elide in speech.

In Lower Luga Ingrian, devoicing and elision in rapid speech are already very frequent. Reduced voiceless vowels are phonologically opposed to short non-initial modal vowels *ü*, *ö*, *u*, *o*, *i*, *e*, *a*, *ä*, e.g. [ˌkuk:**o̥**] ‘rooster:NOM’ vs. [ˌkuk:**o**] ‘rooster:PART/ILL’. The subsystem of these vowels has still preserved all the original contrasts of the initial system from which it has emerged, with the exception of the height contrast for middle vowels: [*ü, *ö, *u, *o, *i, *e, *a, *ä] > [ŭ̥, ŏ̥, ŭ̥, ŏ̥, ĭ̥, ĕ̥, ə̥̆ (<**a*, **ä*, partly **e*)]. Phonologically, it is preferable to treat the vowels in question as reduced rather than voiceless, i.e. /ŭ, ŏ, ŭ, ŏ, ĭ, ĕ, ə/. This is motivated by the fact that *ə* also occurs in positions where it cannot elide due to phonotactic and speech production restrictions, e.g. [ˌłam:**ə**z] ‘sheep:NOM’. In such cases, *ə* is pronounced as a reduced but not a voiceless vowel. We can therefore state that reduction should be treated as the main feature that triggers devoicing in some, but not all, contexts.

In Siberian Ingrian/Finnish, reduced vowels have completely lost the original height contrast. The system now contains two binary oppositions, in backness and labialization: [ŭ̥,

ĭ̯, ă̯ (<*a*, **ä*, **e*), ŏ̯ (<**u*, **o*, **ö*)]. This system can be already described through the consonantal features of palatalization and labialization (*t* stands for any consonant): [tʲĭ̯, tă̯, tʲŭ̯, tŏ̯] = /tʲ, t, tʲʷ, tʷ/. Such an interpretation is even preferable for this variety, at least according to the speakers' introspection, especially in comparison with Lower Luga Ingrian speakers. The latter always interpret their reduced voiceless vowels as vowels (apart for *ə*, whose existence they tend not to perceive at all). This comes clear from the interviews and manuscripts by the Lower Luga Ingrian speakers. For example, they would always transcribe [ˌkuk:ŏ̯] 'rooster:NOM' as *kukko*, just as they would do for [ˌkuk:o] 'rooster:PART/ILL'. Speakers are thus not able to depict the existing phonological contrast in writing. Meanwhile, the speakers of the Siberian variety would claim that there is a special kind of 'k' sound in words like [ˌkukʷ:] 'rooster:NOM', but no final vowel at all. If asked, they would write it down as *kukk*, while [ˌkuk:**o**] 'rooster:PART/ILL' as *kukko*. At the same time, here [ˌkukʷ:] becomes homonymic in writing with [ˌkukᵊ:] 'flower:NOM' (<**kukka*). Some speakers with the most advanced degree of reduction even claim that these two words do not differ in pronunciation. However, the majority of Siberian speakers still perceive the pronunciation of these words as non-homonymic.

If to adhere to the interpretation of voiceless vowels through the consonantal features, the Siberian variety is left with an ample transitory system of consonants. The majority of consonants come to have four variants: plain, palatalized, labialized and labialized palatalized. Many of such consonants are marginal and have a vague phonological status, as their positions or occurrence are extremely restricted and these additional features are not stable in realization for some groups of consonants.

On the basis of the closely-related and geographically adjacent language of Estonian, where the original short vowels were completely lost exactly in the positions where the two varieties of Russia have eliding voiceless vowels, a considerable simplification is expected for such a consonantal system. In Estonian, no traces of consonantal labialization remained (cf. *kukk* 'rooster:NOM'), and palatalization was preserved only for the dental consonants. Taking Estonian facts into account, the following evolution would be expected for the Siberian Ingrian/Finnish system: /t, tʷ/ > /t/ and /tʲ, tʲʷ/ > /tʲ/.

The Finnic example thus supports the model for the typical evolutionary path of voiceless vowels proposed by Blevins. Moreover, it offers data for better understanding of the particular stages of this evolution. At the same time, the example analyzed also shows that voiceless vowels do not necessarily disappear from the language immediately after their emergence, but can be maintained over long periods. The reduced voiceless vowels were presumably present in Lower Luga Ingrian already at the point where the Siberian Ingrian/Finnish variety split with it. These vowels have thus been already preserved in both varieties for at least two centuries.

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Sound change in Australia: Current Knowledge and Research Priorities

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Australian languages are often cited for the unusual degree of homogeneity in their synchronic phonologies. In contrast, the fact that their diachronic sound patterns are equally if not more atypical has received little attention. We delineate the nature of the problem posed by sound change in Australian languages, and identify promising directions for the elucidation, and explanation of this uncommon state of affairs.

THE POVERTY OF AUSTRALIAN SOUND CHANGE In the comparative method, demonstrations of cognacy play a central role. A convincing demonstration requires regular correspondences, of which a significant number involve non-identical sounds. Non-identical sounds are necessary, since correspondences that are merely identical could result not only from shared descent, but from heavy borrowing. Potential cognates in Australian languages display a degree of phonological similarity which, to our knowledge, is simply not encountered in language families in other parts of the world. Within Pama-Nyungan, for example, potential cognates are often near-identical, and furthermore there is little recurrence of correspondences as the number of cognate sets is only around 200. Given its atypicality, is not surprising that current theory provides few answers as to what to do with such data. Yet while most historical linguists will never face the problem of having an overwhelming majority of their sound correspondences being near identical, in the Australian case it is an issue which demands some kind of response, and presents both a puzzle and a challenge for theories of sound change.

THE POVERTY OF AUSTRALIAN PHONOLOGICAL DIVERSITY What, then, are the tools we have to work with? Synchronically, Australian languages display uniformity in static properties of their phonological systems – phonemic inventories, phonotactic constraints, morpheme structure conditions, and metrical systems. A point worth noting however, is that these metrics ignore the question of dynamic (morphophonological) alternations. Since the synchronic morphophonological alternations in any language typically have sound change antecedents, one might hypothesize that on a continent of absent sound changes, morphophonology should likewise be impoverished. In fact though, this is not the case.

THE POVERTY OF DIVERSITY RECONSIDERED Results emerging from Round's large survey of Australian languages' morphophonology may provide new insight into Australian phonological diachrony and synchrony. If synchronic deletion and lenition processes reflect diachrony in at least most cases, then one effect of Australian sound changes is a tendency to preserve the typical Australian phonemic inventory and phonotactic patterns. Additionally, these new findings may shed light on the lack of observed changes in Pama-Nyungan roots. Butcher (2006) argues that post-tonic consonants in Australian languages occupy prosodically 'strong' positions. Assuming that these are resistant to changes such as lenition and deletion, a consequence is that the typical disyllabic Pama-Nyungan root will not contain the most common targets of sound change. Further exploration of links of this nature strike us as promising.

THE ROLE OF MULTILINGUALISM Another question worth considering is whether the paucity of sound change and apparent high rates of lexical replacement may, in part, be the result of normal transmission in a multilingual context. Results emerging from an experiment by Ellison and Miceli investigating lexical choices in code-switching bilinguals show a statistically significant bias towards the avoidance of word forms that are shared (cognates or borrowings), if alternative, distinct word forms are available in the target language. Simulations show that, diachronically, this would result in a fast depletion of cognate word forms from related languages in sustained, multilingual contact. This type of methodology, combining experimental observation with simulations, could also be extended to the study of phonological categories, potentially yielding further insights into the problem of Australian synchrony and diachrony.

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Adoption, Maintenance and Loss of Click Contrasts

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Clicks are rare consonants cross-linguistically, yet they are extremely common in lexical roots in some languages. Sound changes involving rare sounds may be difficult to trace if the number of independent tokens in which they occur is low, making regular, repeated sound correspondences difficult to identify. Here, I compare the patterns of retention, loss and spread of the bilabial ʘ and palatal ǂ clicks. These click types occur in fewer languages than alveolar ! and lateral || click types but they differ in that the bilabial click is relatively rare in the lexicons it occurs in, while the ǂ click usually occurs in a much larger percentage of roots.

Palatal clicks have been lost in cases involving language shift. They have been lost through merger with alveolar clicks (as in |Xam, Griekwa) or merger with palatal consonants and glottal stop (||Xegwi, East Kalahari Khoe, Kwadi). Palatal clicks were reintroduced into |Xam, and contact may have helped preserve ǂ in N|uu and ǂHoan. Bilabial clicks are not lost, in spite of their high confusibility with the dental click (Traill 1994). This may be linked to sound symbolic functions they perform in the lexicon.

All attested cases of borrowing of ǂ have involved language shift. Palatal clicks have been borrowed into Yeyi and Fwe (Bostoen & Sands 2012), languages which already had a palatal series of consonants, but they were not borrowed into Zulu or Xhosa, which lacked the category. Bilabial clicks may not have spread due to the low functional load of the bilabial category in potential recipient languages.

Factors that play a role in the adoption or loss of click contrasts include: 1) language contact involving a high proportion of language shift; 2) the presence of a robust phonological category in which the clicks can be integrated, 3) presence or absence of the click type(s) in contact languages. Conscious language manipulation plays a role in the spread of clicks through the lexicon.

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On a 'crazy rule' of Ancient Greek

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1. The problem. 'Crazy rules' are rules that do not seem motivated by 'natural principles' (Scheer forth.). They are usually explained in relationship with their diachronic origin: a number of diachronic events telescopated and resulted in an unusual alternation. However, these explanations raise important problems for phonological computation: should phonology be able to compute such non natural alternations, or are they just inert results and accidental gaps? If they are synchronic rules, are they formally different from the changes that brought them, and what types of differences can be observed? To what extent can a rule be crazy, and can we draw a line between objects that can be arbitrarily manipulated by phonology and objects that cannot? Our communication proposes to address those three questions by looking into detail at a potential 'crazy rule' of Ancient Greek (AG), which turns all stem-initial *r*'s into geminate aspirated *rr*^{h}'s.

2. Why *rr*^{h}- is crazy. Stem-initial *r*'s in AG are predictably geminated and aspirated.

a-rr^{h}*yt*^{h}*mia*	'lack of rhythm'
alla # rr^{h}*akiois*	'but with rags', Ar. *Frogs* 1066

Its phonetics can be roughly reconstructed as [ɹ̥]. This pattern is arguably 'crazy': the two properties of *rr*^{h}-, gemination and aspiration, are both highly marked, and useless for distinctivity. Among them, non-distinctive aspiration automatically attributed to geminate *r*'s does not seem to have any phonetic motivation. The second property, initial gemination, stands at the juncture between two different problems: on the one hand, stem-initial 'strong' *r* is observed cross-linguistically (as in Ibero-Romance, cf. Bradley 2001); but it does not seem to create syllable structure as it does in AG. On the other hand, if AG allows initial geminates, why does it have only one?

3. Is it a rule or an accident? The '*rr*^{h}- rule' is thus highly suspicious: can it be handled by phonological computation? We provide arguments suggesting a positive answer: *rr*^{h} arises from different diachronic sources (see §4), appears in loanwords (ex. *miso-rr*^{h}*ōmaios* 'hating Romans') and is surface-true: exceptions to its application can be shown to be linguistically regular. In particular, an important parameter is variation across registers and prosodic boundaries (Stephens 1990). However, gemination and aspiration need to be distinguished as two different rules.

4. The changes are different from the rules. We thus need rules to account for *rr*^{h}-, and we need them to apply to a specific context: the beginning of the stem. However, sound change should not be directly sensitive to morphological structure. We reconstruct the different layers of change that resulted in the Classical pattern (from **sr*-, then **wr*-, later through the apparition of word-internal -*rr*^{h}-), and propose a succession of reanalyses that each of these evolutions could trigger. The different changes are shown to differ from the synchronic rules with regard to domain of application, 'structure-preservingness' and phonological content.

4. What is crazy and what is not. Although aspiration does not seem to be explainable on any ground other than diachronic, the case of gemination requires discussion. We provide evidence from Archaic Greek suggesting that other sonorants could be non-distinctively geminated stem-initially in a previous stage of the language (Chantraine 1958, Lejeune 1972):

e-llabe	and *e-labe*	'he took' (Class. G. *e-labe*)
kata # mmoiran	and *kata # moiran*	'as is right' (Class. G. *moira*)

We examine the etymological properties of these sonorant geminates and suggest that both their behaviour and their subsequent disparition may be explained if we distinguish between two different types of constraints in AG: a constraint prohibiting initial length *contrast*, and a constraint prohibiting initial geminates *per se*.

Bantu Spirantization is a reflex of vowel spirantization

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Two series of high vowels are traditionally reconstructed for Proto-Bantu (PB), termed first-degree (*ʯ, *į) and second-degree (*u, *i, or *ʊ, *ɪ). The exact phonetic realization of the two first-degree or super-high vowels is a topic of some debate. We show that for Southwestern Bantu, the mutating effects that the first-degree vowels have on preceding consonants, known collectively as *Bantu Spirantization*, point to vowels with significant spirantization, or *fricative vowels*, as attested in (e.g.) Swedish, Chinese, and the Grassfields Bantu languages (Connell, 2007).

The prevailing account is that the PB first-degree vowels are reconstructable as familiar cardinal [i] and [u]. Proponents of this account note that affrication or spirantization triggered by plain high vowels in non-Bantu languages—such as Japanese (Schadeberg, 1994), in which [ti] and [tɯ] develop to [tʃi] and [tsɯ]—mirrors the range of attested outcomes of Bantu spirantization. An alternate account (Zoll, 1995) argues that the first-degree vowels are characterized by (near) consonantality or increased oral constriction. This account relies upon two assumptions that we confirm here: the range of sound changes comprising Bantu Spirantization *is not* consistent with the attested effects of [i] and [u] but *is* consistent with the attested effects of fricative vowels.

Data from Southwest Bantu (Fig. 1) suggests a spirantized reconstruction of *ʯ and *į. A sampling of the attested sound changes in this subgroup of Bantu shows that "spirantization" results in manner and place changes that one might associate with palatal or labial gestural overlap, but also an atypical neutralization of place contrast before first-degree vowels. While reconstructing Bantu *ʯ and *į as cardinal [u] and [i] is a significant and possibly unwarranted addition to the set of consonantal sound changes associated with those vowels, the consonants of SW Bantu *do* reflect sound changes associated with fricative vowels. Fricative vowels frequently change initial consonant place and add strident frication (1), likely due to the presence of fricative noise over the formant transitions that identify initial consonants.

The development of the first-degree vowels themselves in SW Bantu also suggests an atypical value for *ʯ and *į, in particular the lowering and fronting changes. Fricative vowels tend to have more centralized F2 and higher F1 than would be expected for similar cardinal vowels [i] and [u] (Engstrand et al., 2000); they are also often variably realized as "broken" into a fricated portion followed by more vowel-like portion of a central, lowered quality (2). Note that languages may progress to a "broken," centralized realization (Oku, 2b), sharing a non-high vowel quality with Bantu Spirantization as seen in SW Bantu.

Knowledge of the typology of possible and expected sound changes is essential in determining the phonetic realization of reconstructed segments. We aim to add to this typology by examining the historical development of an unfamiliar class of sounds and using this to address one of the great mysteries of Bantu historical phonology.

PB CV sequence	*pį	*tį	*kį	*bį	*dį	*gį	*pʯ	*tʯ	*kʯ	*bʯ	*dʯ	*gʯ
Herero	θe	θe	θe	ðe	ðe	ðe	θu	t̪u	t̪u	ðu	ðu	ðu
Ndonga	θi	θi	θi	ði	ði	ði	fu	swi	swi	vu	zwi	zwi
Umbundu	si	si	si	vi	ji	ji	fe	te	ke	ve	le	(j)e
Ila	ʃi	ʃi	ʃi	ʃi	ʃi	ʃi	fu	fu	fu	vu	vu	vu

Figure 1: Southwest Bantu reflexes of Proto-Bantu CV sequences. Data from Brincker (1886); Etaung Daniel (2000); Fowler (2000).

(1) **Initial place change in Ring langs.**
(Hyman and Jisa, 1978)
*kʯn → Kom *kʏn*; Babanki *pfɛn* 'hill'
*bį → Kom *bz̩*; Aghem *dzɨ* 'to give birth'

(2) **Spirantized vowel breaking**
a. Free variation: *ʯ → [ʏ] ∼ [və] (Kom)
b. No variation: *ʯ → [(v)ə], *[ʏ] (Oku)

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Confusion of tense and modality? Impact of L1 phonological transfer on verb semantics

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In the Roman period Egypt, Greek was the official language of the government, and all the official as well as most of the unofficial correspondence was written in Greek. Despite the fact that scribes were trained in Greek, texts show a vast variety of phonological and morphosyntactic non-standard variation. Some variation is due to phraseology, some to linguistic change, some to variation in genre, some is contact-induced, and some is due to a bad command of Greek in general. The data presented here consists partly of private letters from the Eastern Desert of Egypt, showing general tendencies of Egyptian phonological influence, and partly of scribal documents from the Northern part of the country, giving evidence for underdifferentiation of foreign phonological units specific to the impact of Egyptian.

Egyptian being an Afro-Asiatic language, consonants strongly affected the quality of the adjacent vowels. Underdifferentiation of foreign phonemes, as well as L1 prosody-based phonological influence, caused a misperception of Greek phonology, visible in the many non-standard graphemic variants of the Greek words. For instance, as there was no /y/ in Egyptian, there was a great deal of fluctuation between the graphemes <u> and <y>, both apparently representing some sort of rounded back vowel present in Egyptian. Another common error concerns the Egyptian tendency to reduce unstressed vowels to schwa, a phenomenon evident in the confusion of marking /a, e, o/ in Greek unstressed syllables. In Greek these were distinctive phonemes, even in unstressed syllables, and furthermore bore morphological meaning. The Egyptian phonological transfer thus indirectly produced semantically ungrammatical verb forms, the non-standard orthography inadvertently creating confusion between tense and modality. In this presentation, we show some verb constructions with seemingly causeless variation in the use of modality and tense as well as aspect, on the surface level appearing to reflect morphosyntactic confusion, assumed to result from inadequate language learning. When looked at more closely, however, the non-standard inflectional behaviour seems to be caused by misperception of Greek phonology due to the impact of the writers' L1.

Some of the verb forms have a grammatically faultless appearance but on closer inspection, they turn out to be problematic. We can take, for example, the forms *pémpson* [´pempson] and *pémpse* [´pempse] from the verb *pémpo*: [´pempo], 'send'. The editors of the texts often have difficulties in deciding which one is the intended form: sometimes *pémpse* [´pempse] is analysed as an imperative, sometimes as an imperative or an infinitive. If the graphemic writing forms are taken to be exact, there will be semantic confusion regarding the intended meaning of the verb. The situation might gain some clarity if we analyse the language use on a more individual level. Among the examples presented here are some verb forms used by a person called Petenephotes, a composer of several Greek letters. His use of verb forms deviates from the Greek standard usage, but is in line with the usage of those with L1 Egyptian. If we take again the verb *pémpo:* [´pempo], we find even more variation than mentioned above: the forms *pémpse* [´pempse] and *pémpson* [´pempson] and *pémpsen* [´pempsen] are all used in a similar context. This variation clearly has a phonological basis, as all endings seem to blend together, apparently depicting the Egyptian-influenced phonetic form [´pempsə]. Petenephotes even uses *pémpsai* [´pempse] in a similar context. The same phenomenon is evident in the Coptic usage of Greek loanwords, even though the written Coptic sources are from a later period than the Greek texts: in Coptic dialects, the graphemes <e> and <o> were standardly used to depict schwa. As the phenomenon not only concerned Greek unstressed syllables but stressed ones as well, it may be possible to conclude that inadvertent transference of the Egyptian stress system might have caused Greek stressed syllables to be perceived as unstressed. The confusion of /a, e, o/ visible in the verb forms might therefore be a reflection of the Egyptian writers' attempt to depict the unstressed syllable's schwa.

Social variables facilitating subphonemic shift in Nigromante Zapotec
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This study examines non-indexicalized variation between two liquid taps within a small speech community. Speakers born after 1950 have high rates ($\sim$ 80%) of one tap, [ɾ], and not [ɹ], the more conservative variant of the phoneme /ɹ/. I consider this to be a sound change in progress that has nearly reached completion. Considering that those born before 1950 have $\sim$30% of the [ɾ] variant in their speech, this sound change rapidly propagated throughout the Nigromante Zapotec (NMZ) speech community (Johnson 1976). I suggest that this rapid rate of change results from the small-world network that comprises the community of NMZ speakers. Small world social networks have been shown to increase rate of propagation of social variables requiring reinforcement (Watts 1999; Centola and Macy 2007).

[ɾ] was not formerly present in NMZ, so the change in question is subphonemic. An Oto-Manguean language spoken in a small town in southern Mexico, NMZ has only 2,600 speakers. Most are bilingual in Spanish. Previous studies of small, isolated speech communities have shown that integration within the speech community, as well as elevated contact with people from the outside, are important predictors of innovation in rural towns (Romero 2009; Lippi-Green 1989).

Analyses of NMZ wordlist data suggest that the spread of innovative /ɾ/ in NMZ correlates best with age. However, speaker age is also loosely correlated with level of integration into the NMZ speech community. These findings are similar to an analysis of phonological variation of vowels in a rural German community, where younger speakers were more likely to innovate, especially if they had more contact with people from outside the village (Lippi-Green 1989).

The NMZ shift from [ɹ] to [ɾ] has solidified nearly within a generation. Similarly rapid rates of change can be found in other small, closed, bilingual communities (e.g., Lai and Hsu 2013). These speech communities are prime examples of small world networks. In a small world, complex contagions (those which require reinforcement) can spread much more quickly than they can in any other kind of network (Centola and Macy 2007). My analysis suggests that sound change does not take place at a constant rate, and is highly dependent on the culturally-governed social structures through which it is propagated. Given the right social network conditions, a subphonemic or phonetic change can solidify several times faster that it would in other social environments. This can allow us to better understand and predict the spread of sound change in many other languages and language families.

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Devoicing of /v/ in Dutch: linking perception and production

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In this paper we report on work in progress on the link between the perception and production of the /v/-/f/ contrast in Dutch at both the group (region) and the individual level, as part of a study seeking an answer to the so-called *actuation problem* (Weinreich et al. 1968).

The devoicing of word-initial labiodental fricatives has been shown to be a change in progress in Dutch. It is a distinct characteristic of Netherlandic Standard Dutch, but in recent year it also started showing up in Flanders (Kissine et al. 2004). Furthermore, there is regional variation in the degree of devoicing of /v/ and in the acoustic implementation of the /v/-/f/ contrast. On the basis of insights from Kissine et al. (2004), five regions in the Dutch language area were selected, geographically representing the change from a full /v/-/f/ contrast to a near merger:

1. West-Flanders: almost completely voiced /v/
2. Flemish-Brabant: core area in Flanders, incipient devoicing
3. Netherlands Limburg: weak devoicing of /v/
4. Netherlands South-Holland: core area in the Netherlands with strong devoicing
5. Groningen: almost complete devoicing

For each region, 10 men and 10 women, highly educated, and between 18 and 28 years old were selected (k=100) and participated in a series of production and perception experiments.

First, we discuss the results of a forced-choice categorization task. In this task, the participants had to categorize 405 labiodental fricatives as being either voiced (v) or voiceless (f). The fricatives were phonetically manipulated along two dimensions (degree of periodicity and duration). We expected to find cross-regional differences in perception and hypothesized that the perception would be the most categorical in regions where the devoicing process has not yet started, and the least categorical in regions where the process of devoicing is almost completed. The results of this task were analyzed with a mixed effect logistic regression. The obtained psychometric curves confirmed our hypotheses and showed that the five regions significantly differ for periodicity. The differences in steepness of the slopes show that perceptual patterns are more categorical in the regions West-Flanders and Flemish-Brabant than in the Netherlandic regions. The order of these slopes reflects the stages of the sound change stated above. As expected, only plays a minor role, but the observed perception patterns are in line with Kissine et al. (2004).

As a next step, we analyze our production data. Each participant was recorded in a range of different speech styles, with different degrees of monitoring (word reading, sentence reading, semi-spontaneous speech and spontaneous speech). All tokens of /v/ and /f/ were measured along the same phonetic dimensions as in the perception task. The production patterns will be analyzed (1) cross-regionally and compared to (a) the previous production studies (Kissine et al. 2004) and (b) our perception study, and (2) at the individual level, which will allow us to investigate the link between the production and perception of variation more accurately. More specifically, we focus - within each region - on the most conservative individuals and on the leaders of change, and investigate how their production patterns relate to their perception, and might provide a clue to the solution of the actuation problem.

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Phonetically conditioned sound change: /u/-fronting in Souletin Basque

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Front rounded vowels are relatively rare cross-linguistically, but appear to be an areal feature of (northern) Europe, where they occur in Germanic languages, Gallo-Romance languages, Breton, and Hungarian, among others. In many cases, these frontings have been attributed to context-free processes, including chain shifts.

In this paper I present the case of Souletin Basque (see Hualde 1993), which has been a puzzling problem for bascologists since it was first described by Uhlenbeck (1903: §5). Souletin is the easternmost Basque dialect and has been in close contact with Gallo-romance languages including Bearnese Gascon and, more recently, French, for some time.

All Basque dialects show basic vowels /i u e o a/, but Souletin is the only dialect that has developed a sixth contrastive vowel, /y/ (cf. Egurtzegi 2013: 127-130). This paper provides a general account of the development of /y/ via u-fronting (cf. /s̪y/ ‘you’, /egyn/ ‘day’, etc.), as well as a detailed analysis of the contexts that inhibit this palatalization (cf. /ikʰus̪i/ ‘to see’, /s̪urɐ/ ‘your’, /urtʰe/ ‘year’, etc.). The sound change of u > y in Souletin also appears to be context free, however it was inhibited when the vowel was followed by an apical sibilant fricative, a tap or an rT cluster (‘r’ a rhotic, T an alveolar obstruent). Somewhat surprisingly, fronting does occur when similar segments such as /s̪/, /r/ or non-coronal rhotic-obstruent clusters follow /u/ (cf. /gys̪i/ ‘all’, /yrhe/ ‘gold’, etc.).

The inhibition pattern is considered in terms of its phonetic content as well as its typological and geographic significance. Since the inhibitory contexts do not form a natural phonological class, we argue for a phonetic source. Both articulatory and perceptual factors seem relevant. Work by Ohala & Feder (1994) and Harrington et al. (2008) point to acoustic and perceptual factors in English u-fronting. At the same time, Recasens & Pallarès (2001: 288) suggest that certain manner configurations, which require a secondary back placement of the root of the tongue to produce fine movements of the tip, may inhibit palatalization. We will argue that this is precisely the case found in Souletin.

In terms of typological patterns, a comparison of Gascon and Basque is illuminating. Gascon shows context-free u > y. Souletin shows the same pattern, but with some inhibitory contexts as described above. This pairing is similar to those found in varieties of American English where, for example, one finds context-free fronting in older Southern American English, and the same change with blocking before dark [ɬ] in many modern varieties.

While contact with Bearnese Gascon appears to be a necessary requirement for the development of this sound-pattern in Basque, the specific inhibitory contexts that the Basque shows, as well as the processes related to the more general back vowel palatalization, seem unparalleled in the neighboring languages, and argue for unique language-internal developments in Souletin.

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When "secondary" cues take over: phonetic changes and resulting phonetics-phonology mismatches

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Hyman's (1976) seminal work on *phonologization* describes how a sound change can occur when an intrinsic phonetic correlate of a phonetic feature takes over the distinctive function of the primary feature, resulting in a change in the phonological system. One of the examples Hyman uses to illustrate this process is the development of rising tones in Southeast Asian languages: some languages enlarge the intrinsic pitch-lowering effect that voiced plosives have on following vowels, which can be interpreted by learners acquiring such a language as a tone contrast with an allophonic distribution of plosive voicing. This allophonic distribution can disappear in subsequent generations, resulting in a pure tone contrast. In phonologization, therefore, a change in the *phonetics* (voicing as primary cue is replaced by a tone cue), is accompanied by a change in the *phonological representation*, though, as Hyman mentions himself, it is not clear what triggered this phonological reinterpretation.

The present study proposes an alternative to Hyman's phonologization proposal, namely a diachronic process that involves a phonetic change where an secondary cue takes over the distinctive function of the primary cue *without* a resulting change in the phonological system. This proposal can be viewed as a case of *Neogrammarian sound change*. Applied to the example of contour tones given above, this would predict a language with an underlying voicing contrast that changes the phonetic realization of the contrast from periodicity to a pitch change across several generations of speakers, keeping the phonological contrast constant.

The proposed type of diachronic change is only possible in a grammar theory with the following three characteristics:

1. a strict division between the phonetic and phonological module (in line with generative grammar theories, e.g. Chomsky & Halle 1968),
2. a non-universal mapping between perceptual cues and phonological representations, which has to be acquired by the language learner and is therefore part of the grammar (Boersma 1998),
3. the mapping between cues and phonological representations is bidirectional, i.e. employed both in the production and the perception process, thus speech perception (and comprehension) is part of the grammar (Boersma 2007).

In this account, the decision whether a diachronic change affects the phonological system can then only be made on the basis of phonological considerations, i.e. by testing whether phonological processes changed across generations. This proposal is illustrated with two diachronic changes that resulted in such *phonetic-phonology mismatches*: The phonetic merger of the two formerly distinct front mid vowels /e/ and /ɛ/ in Chukchi (Dunn 1999), and /u:/-fronting in Standard English of Southern England (Hawkins & Midgley, 2005, Harrington et al. 2008), where F2 diphthongization seems to take over the role of the front-back distinction.

Shifting or Shifted? The state of California vowels

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This study investigates the current state of vowel shifts thought to be occurring in California and provides a detailed account of pronunciation norms for California vowels in comparison to "Standard American English", with consideration of differences in pronunciation by age, region, gender and ethnicity. Data was collected from 37 Californians using the reading passage "The Boy Who Cried Wolf" (Deterding 2006). All participants were born in California or moved to California before their fifth birthday, and speak English as their preferred language. Participants range in age from 18-56 and are from three major geographical regions in California: The San Francisco Bay area; Southern California; the Central Valley. Overall the California vowel space is found to differ from Standard American English (as defined in the *Atlas of North American English* (Labov, Ash, and Boberg 2006)) in the following combination of features: (i) LOT and THOUGHT are merged, with the resulting vowel occupying a low central position; (ii) GOOSE and FOOT are fronted, but GOAT is not; (iii) the front tense vowels FLEECE and FACE are high relative to the lax vowels KIT and DRESS; (iv) TRAP is split, raising before nasals and backing elsewhere. Results from this study suggest that, at least in California, and at least among very broadly defined middle class educated speakers, people from non-white ethnic groups have access to, and participate in, the majority dialect. This is not to say that these speakers may not also participate in ethnically based speech communities. Rather, the dominant dialect cannot be defined as being exclusively white. Additionally, contrary to expectations, there were few statistically significant differences between speakers from different regions or ages, which suggests that the California vowel space is the result of a nearly completed shift, rather than an example of a shift in progress.

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Taiwan Min Checked Tones Change

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Taiwan Min checked tone 5 positioned at final (juncture) position of a tone group is undergoing sound change where the coda [-p, -t, -k, -ʔ] is deleted, the preceding vowel is lengthened and the f0 contour is generally lowered (Ang, 2003, Liao, 2004, Chen, 2009, 2010). This study investigates changes in checked tones 3 and 5 in final (juncture) and non-final (sandhi) position in a tone group. According to tonegenesis theory, the development of tones involves context induced coarticulatory F0 perturbation and perceptual miss-parsing of the resulting F0 perturbation as a vowel intrinsic property (Mei, 1970, Matisoff, 1970, 1973, Hombert, 1976, Ohala, 1993). Following are three research questions addressed here: (1) How are vowel duration, F0, and spectral tilt measures affected by presence or absence of codas? (2) Is there a merging pattern between juncture tones 3 and 5? (3) How does this sound change vary by age, gender and dialect?

Forty speakers varying in age, gender, and dialect region (2 speakers ξ 2 ages ξ 2 genders ξ 5 dialect regions) produced two repetitions of disyllabic words in the mid phrase position of carrier sentence, “Please listen to the tone of __ first.” The sandhi and juncture tones were located at the first and second syllables of disyllabic words respectively. Simultaneous EGG and acoustic signals were recorded with Audacity software onto a laptop. EGG and acoustic signals were separated into two different channels with EggWorks (Tehrani, 2010) and analyzed with VoiceSauce (Shue, Keating and Vicenik, 2009). F0 was calculated using the STRAIGHT algorithm at 1 ms intervals (Kawahara, Cheveign and Patterson, 1998).

Results reveal that, deletion rates of coda [-ʔ] were above 93% among both sandhi and juncture tones 3 and 5, whereas deletion rates of coda [-p], [-t] and [-k] averaged around 60%. Comparison of the same tone across different position reveal that when codas were deleted, both sandhi and juncture tones 3 and 5 were longer in duration, lower in both F0 onset and offset and more periodic in vocal fold vibration. In other words, checked tones were more unchecked-like after changes. These changes support the tonegenesis theory. There were no effects of age or dialect region on all measures. As expected, effects of gender were found among F0 related measures. Comparisons between tones 3 and 5 at the same position reveal that at juncture position, F0 onset and F0 offset values increased for tone 3 and decrease for tone 5. H1*-A2* values increased for tone 5 and decreased for tone 3. F0 onsets of tones 3 and 5 were merging at juncture position, so were F0 offsets and H1*-A2*. It is proposed that the merging of juncture tones 3 and 5 maybe perceptually motivated, Further perceptual studies are necessary.

On the mechanics of tonogenesis: evidence from prevoicing

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Summary. The development of tone in many languages is thought to arise from the phonologization of obstruent-intrinsic F0 ('onset F0'; e.g. Hombert et al., 1979). While onset F0 effects are both robust and perceptible, the conditions under which listeners come to interpret them as a primary cue remain unclear. Here, we explore the idea that tonogenesis may involve a stage where VOT is inversely related to the magnitude of onset F0 (cf. Beddor, 2009).

Background. Kingston & Diehl (1994) argue that F0 is actively lowered after [+voice] stops to enhance perception of the [voice] contrast. Such an 'active' enhancement strategy leads us to expect a trading relation between VOT and onset F0, as found by Shultz *et al.* (2012) for (voiceless) American English stops. We suspect a similar relation may also obtain for *pre*voiced stops, commonly viewed as the initial source of perceptible onset F0 perturbations, such that the shorter the duration of prevoicing, the greater the enhancement of the low F0 property. Such covariance could give rise to conditions under which listeners might come to regard the primary cue to [voice] as one of F0 rather than VOT.

Experiments. We looked for evidence of VOT/onset F0 covariance in 2 non-tonal prevoicing languages, Italian and French. 6 speakers of each language were recorded producing 3 repetitions each of 11 (near-) minimal triplets: two bilabial target items (e.g. *belle ~ pelle, boule ~ poule*) and one rhyming distractor (e.g. *stelle, foule*) in both absolute-initial and word-medial positions. A significant linear relationship between voicing lead and onset F0 was observed in both languages, as modeled by a mixed-effect analysis predicting onset F0 from VOT, voicing, and context, with random slopes and intercepts for subjects and items: the longer the duration of prevoicing, the *lower* the onset F0 ($\beta = 0.08$, SE = 0.03, $p < 0.001$). No such relationship obtained for VOT and F0 in [-voice] stops in either language ($p = 0.84$).

Discussion. While we did find covariance between temporal extent of prevoicing and onset F0, it was not in the direction consistent with the kind of trading relation we expected. However, this finding is biomechanically plausible, as larynx lowering (which correlates with low pitch) is a well-documented strategy to achieve pharyngeal expansion necessary to maintain phonation (Ohala & Riordan, 1979). Active enhancement (hyperarticulation) of prevoicing would thus naturally condition low F0, helping to explain how onset F0 could become exaggerated to the point where listeners might reanalyze it as the primary cue to the laryngeal contrast.

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Sibilants in Italian/Tyrolean bilingual speakers

Goal: This paper presents an UTI-based study on /s/ in Italian as it is spoken in South Tyrol, a bilingual region on the border between Italy and Austria. More specifically it focuses on /s/ in /s/C(C) clusters as produced by sequential or simultaneous Italian/Tyrolean bilingual speakers. The main aim is to describe the articulatory patterns for /s/ in Italian under different conditions and to discuss how they vary according to the nature and the degree of bilingualism of the speaker so to offer new data for the discussion on the sociophonetics of bilingual speakers, in particular as regards covert articulations.
Method: Lingual articulatory data are captured using an Ultrasonix™ SonixTablet ultrasound system coupled to a transducer operating at 5 MHz (FOV: 112,76°; Depth: 8-9cm; Scanlines: 64) and linked to the Articulate Instruments™ AAA software for data acquisition at a temporal resolution of 122/166Hz. Tongue profiles are compared using the approach proposed by Davidson (2006) to determine whether or not tongue shapes for articulation under different conditions are significantly different (SS ANOVA) and, in case, to assess which sections of the tongue profiles are statistically different (Bayesian confidence intervals).
Data: Five adult female speakers of the same age and from the same city but with different degrees of bilingualism are recorded while reading a list of 40 Italian words containing the sibilant /s/ followed by /p/, /t/ and /k/ or followed by /pr/, /tr/ and /kr/ in word-initial as well as in word-internal position as for example in: /ˈskanno/ `(I) slaughter´; /ˈskranno/ `high-backed chair´; /ˈbaska/ `Basque´; /ˈaskra/ `ancient town in Boeotia´.
Results: The inter-speaker comparison of tongue profiles at the fricative acoustic midpoint shows that the informants resort to different articulatory patters. In particular it emerges that the covert apical vs. laminal distinction (Fig. 1) plays a role in contrasting /s/ as produced by monolingual speakers against /s/ as produced by bilingual speakers. This differentiation has negligible effects on the auditory output in the data under scrutiny. These results are relevant to the discussion on the role of bilinguals in promoting sound change, especially as regards a speaker-oriented theory of sound change.
The across-speakers comparison of intra-speaker difference for /s/ tongue profiles under different conditions shows that: (i) as for each possible /sC/ combination in the dataset, the significance of the degree of differentiation in tongue profiles for the same cluster is different across the speakers, but independent from the degree of bilingualism; (ii) as for as for each possible /sCr/ combination in the dataset, the significance of the degree of differentiation in tongue profiles for the same cluster is the same across the speakers, hence independent from the degree of bilingualism; (iii) as for word-initial vs. word-internal allophones the significance of the degree of differentiation in tongue profile is the same across speakers, hence independent from the degree of bilingualism. These preliminary results are relevant to the discussion on the role of instrumental articulatory techniques in dialectology and sound change, in particular because they provide new insights concerning sociolinguistic variation in the light of the debate on what is planned by the speaker or due to the anatomical and physiological properties of the tongue.

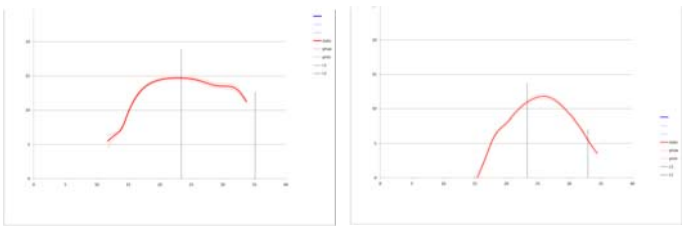

Fig. 1: Apical vs. laminar articulation of /s/ in a monolingual (right) and a bilingual (left) speaker respectively. In each image the tip of the tongue is on the right and the two slashes point to the constriction location for /k/ and /t/ respectively.

Extreme high frequency, segment deletion and chunking: a study of emerging inflected pronouns in Brazilian Portuguese

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Research in usage-based theory has shown high frequency words and phrases are most prone to phonological and semantic reduction, which may in turn become part of a language's morphology via the process of *chunking* (Bybee 2010, 1985, Bybee et al. 1995, Hopper & Traugott 1993). The present paper reports on the extreme reduction of the prepositions *para* ['pa.ɾə] 'to' and *de* [dʒi] 'of' in the high frequency context of preposition plus oblique personal pronoun phrases in the Belo Horizonte dialect of Brazilian Portuguese.

Due to its high token frequency, the full form ['pa.ɾə] had already been reduced in spoken language to ['pɾa]. However, in the extremely high frequency phrases made of preposition and oblique pronouns, the preposition has been reduced even further, yielding [pɾ] or even [p] for all persons except 1S. Likewise, the proposition *de* reduces from the already shortened [dʒ] to extremely reduced [d] in equally high frequency contexts. Because the pronouns show highly reduced form themselves, the result of this new sound change are pronominal chunks made of preposition and oblique forms of pronouns. The table below illustrates the forms resulting from the segment deletions .

Person	Direct pronoun	With *para*	With *de*
2s	você [se]	para você > [pɾo'se]	de você > [do'se]
3s	ele [elʲ] / ela ['ɛlə]	para ele/ela > [pɾelʲ] / [prɛ̨]	dele [delʲ] / dela [dɛ̨]
1p	a gente [a'ʒẽtʃ]	para a gente > [pɾa'ʒẽtʃ]	da gente > [da'ʒẽtʃ]
2p	vocês [ses]	para vocês > [pɾo'ses]	de vocês > [do'ses]
3p	eles [elʲs] / elas ['ɛ̨əs]	para eles/ elas [pɾelʲs] / [prɛ̨əs]	[des] / [dɛ̨əs]

The interplay between sound deletion in unstressed syllables due to high frequency and the similarly high frequent collocation of preposition and pronoun may be giving rise to a new set of inflected prepositions - bearing a resemblance to the system found in Celtic languages (Ball & Müller 2009). In addition, given the decline of the use of clitics in Brazilian Portuguese (Cook 1997, Ramos 1997, Lopes 2008), the combination of reduced prepositions and reduced pronouns may signal the emergence of a new paradigm of case distinctions coded by prefixes.

A corpus study was carried out to investigate the occurrence of reduced forms in the dialect. Collocations of prepositions *para* and *de* plus pronouns were examined in a spoken corpus of spontaneous interactions of speakers of the Belo Horizonte dialect of Portuguese (Raso & Mello 2012). Each token occurrence was analyzed acoustically using Praat (Boersma 2001) with respect to the following variables: vowel deletion, consonant deletion and syllable deletion in both preposition and pronoun.

Results suggest that the sound deletion is already advanced in the dialect, especially for the preposition *para*. The extremely reduced version of *para* to [p] is confined to the most frequent pronoun used in spoken discourse, that is, 2S. As a consequence, an uncommon consonant cluster is produced (e.g, [pse]). These data corroborate previous accounts of vowel reductions leading to new consonant clusters in the dialect (Napoleão de Souza 2012).

It has been shown that frequency of use leads to phonetic reduction which consolidates itself in phonological change. In the case of reduction in extremely high frequent phrases, a new grammatical morpheme may be created though the process of chunking. The data gathered in this study point to a close relationship between sound change and grammatical innovation. The present results reinforce the theory that usage not only influences but also gives rise to grammar. In this sense, the gradual lenition and deletion of segments may indicate the pathway through which language changes.

Usage of non-canonical forms in Colombian Spanish vowel sequences

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Although in citation form the articulation and syllabification of Spanish adjacent vowels as tautosyllabic (diphthong) or heterosyllabic (hiatus) is widely predictable, different studies report patterns of variability. Heterosyllabic sequences tend to be avoided and resolved via a variety of strategies including diphthongization, elision, coalescence, and epenthesis. Hiatus resolution is reported to be widely spread in Latin America (Frago Gracia, J. and M. Franco Figueroa 2001, Garrido 2013), however this phenomenon of phonological variation has been historically associated with social stigmatization (Alonso 1930). For example, hiatus sequences resolved via diphthongization (e.g. teatro>['tja.tro] 'theater') are generally described as characteristic of uneducated or lower social class speakers. Further evidence of the negative social evaluation given to some forms of hiatus resolution is the usage of hypercorrect forms, in which speakers, in an effort to avoid the stigmatized articulation, transform a canonical use of the word into a non-canonical hiatus sequence (e.g. monopolio (canonical) > monopoleo (hypercorrect) 'monopoly'.

This paper analyzes speakers' attitudes and the reported usage of non-canonical forms resulting from hiatus resolution and hypercorrect forms in Colombian Spanish. Data were collected from a total of 150 participants aged between 18-30. Participants were asked to listen to a set of phrases and evaluate the correctness of each phrase on a scale of 1-5 (with 1 being the least correct and 5 being the most correct). The evaluated phrases included cases of diphthongization, elision, epenthesis and hypercorrection.

Preliminary results suggest that the non-canonical pronunciation of Spanish hiatus sequences has a considerable degree of acceptability among young speakers. When grouped by hiatus resolution strategy, results show that the cases of elision received an average score of 2.85, followed by diphthongized forms with 2.57 and epenthesis with 2.34. On the other hand, cases of hypercorrection, which are generally explained as a reaction to the stigmatization associated with hiatus resolution, show a remarkable degree of acceptability as well, with a score of 2.36. Results also indicate that the acceptability of non-canonical forms vary from one lexical item to another (e.g. peor> [pjoɾ] with an average score of 1.35 vs. petroleo [pe'troljo] 'oil' with a score of 3.94). These findings provide evidence of the crucial role of social evaluation on the spreading of sound change. The degree of acceptability of the non-canonical forms discussed here is relevant to the study of phonetic/phonological variation as a process that may be motivated by internal forces, but is mediated by external factors at the speech community level. The usage and acceptability of a given form plays a determining role on its diffusion or retraction.

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Biphonetic Conditionings on Middle English /h/-dropping

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In view of the crux on the contemporary theories, phonetic basis is applied to specific internal cases and prosodic approach to allophones to which ambisyllabicity does not hold. Both of the accounts make sense both in the English language and on controversial issues, but it is interesting, if any, to seek for and establish the all-inclusive unified architecture with the universal applicability.

The functional account behind the surface variants points to multiple phonetic effects: mono-conditioning in the level of syllable and two independent ones on prosodic allophones. The reason for the latter comes from general features on syllabic constituents. Assume the general disposition that an allophone in coda is likewise syllabified to onset and that the coda lenition and the onset fortition take precedence. The lenition thus proceeds at the two counteractive positions. The prosodic allophones are rare or unique for the sounds and entail the second phonetic grounding in each of them.

Note that my argument is properly accountable by way of the Evolutionary Phonological UG (cf. Blevins 2010, Kiparsky 2008). Typological generalizations differ from true universals in the sense of associating with specific diachronic paths in grammar. The specific diachronic paths, in the short span, for the prosodic allophones are (a) from lower to higher hierarchies, (b) increase on the emergent forms, and (c) from monophonetic to biphonetic conditionings. The effect the contemporary UG has on the allophonic theory leads to the apparent acceptability in the crosslinguistic investigation.

The empirical focus is attributed to the ME /h/-dropping: (a) the weak forms as in the pronoun *his* and the auxiliary *have* and (b) the content words with the French origin, as in *habit*, *history* (cf. Crisma 2007, Häcker 2004, Johannesson 2000, Laing 2008, Laing and Lass 2010, J. Milroy 1983, J. Milroy and L. Milroy 2002, Minkova 2004, Schlüter 2003, 2009). The Schlüter's works, in particular, suggest that the /h/-deletions stem from vocalic onset, where the phonological interpretation is realized as the phonetic form. Laing and Lass present the similar idea to it.

On the contrary, this paper posits two articulatory bases on the /h/-dropping, which are capable of better accounting for the integrated derivations and the sound-related phenomena. For the /h/, the friction occurs throughout the vocal tract. The air flow is suppressed. The occurrence for, say, /s/ is not affected by the stress displacement. The production on the weak forms at the laryngeal, however, leads to no friction. The /h/-deletions in prosodically weak positions are also illustrated in Turkish and Hebrew. The shift in them is regarded as phonetically less marked than the one shown on the ME content words. The two features make the contrast in terms of being either intrinsic or partial.

The other deletions stem from the sequential effects. When making the /h/, speakers prepare the state of the glottis for the following vowel. The narrow posture leads to no friction. The sequence high front vocoid + rhotic in *(h)irchoun* 'hedgehog' (commonly /h/ deleted) gives rise to, if any, the weak friction. In contrast, the friction in *hautein* 'high class' (commonly /h/ pronounced) is clear. The low vowel and the diphthongal glide facilitate to convey the suppressed friction.

The vocalic onset as claimed in Schlüter (2003, 2009) fails to capture language-internal issues. As described in the English historical works (cf. Fisiak 1968, Markus 1990), (a) in the prosodically weak positions of OE, the /h/-dropping was progressive, prior to the post-Conquest influence, and (b) the reoccurrence on the content words was much earlier than that on the function words. On account of the biphonetic conditionings, the /h/-less forms in the function words are shown to be less marked and the friction is unlikely to occur in the weak forms. This is why the two phenomena shown above are based on the laryngeal articulations.

All of the variants in OE are enough to be accounted for by ambisyllabicity. Posttonic positions are explicitly divergent from pretonic ones. In a sense, the ME /h/-dropping is inapplicabale to the origin of the prosodic allophones. The syllable onset is solely sufficient. In other sense, it serves as the *indirect* origin on it. Like the descendants, biphonetic conditionings independently hold to it. The weak sounds might be essential, and the same shift occurs in the stressed environment.

Self organization in Plural Forms in Brazilian Portuguese

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This paper addresses sound changes which are related to the loss of plural markers in Brazilian Portuguese (BP). Any plural marker in BP may be alternatively omitted as long as the determiner retains the plural marker (Naro & Scherre 2013). Thus, we find forms in competition such as 'os menino**s** bonito**s**' and 'os menino bonito' *the handsome boys* or 'un**s** dias chuvosos' and 'uns dia chuvoso' *some raining days*. The definite or indefinite article retains the plural marker – which is underlined in the examples above – whereas the plural markers are not present in the nouns and adjectives. The loss of plural marker is an ongoing phenomenon in BP and we will argue that its current state reflects patterns of self-organization in a complex system. We adopted a Complex Adaptive Systems approach to interpret our findings (Beckner et alii 2009; Ellis and Larsen Freeman 2009, Bybee & Beckner 2013). We will argue that the current sound changes related to the loss of a plural marker in BP actually reflect trajectories which contribute to the stabilization of a more general configuration in the language which is the morphological loss of plural markers in noun and adjectives. Regular plurals in nouns/adjectives in BP are formed by adding an (-s) to them: (kaza+s) > (kazas) 'house'. Irregular plurals may fall into five different groups. Group 1 refers to nouns/adjectives ending in (-s) which take the suffix (-is) where the final (s) of the nouns becomes voiced: (mes+is) > (mezis) 'months'. Group 2 encompass nouns ending in [h] which take the suffix (-is) where the fricative becomes a tap: (koh+is) > (koɾis) 'colours'. Group 3 involves nouns/adjectives which have a primarily stressed back mid-high vowel where in the plural form, when (-s) is added, the mid vowel will manifest as a mid-low back vowel: (ovu+s) > (ɔvus) 'eggs'. Group 4 refers to nouns ending in (ão) which may have three different plural forms: ãos, ães, ões as in (mão+s) > (mãos) 'hands'; (pão+s) > (pães) 'bread (pl)' and (leão+s) > (leões) 'lions'. Group 5 is related to nouns ending in a lateral which is vocalized in BP: (sal) > (saw) 'salt'. The plural form in this group takes the (-is) ending and the vocalized-L disappears: (sal+s) > (sais) 'salt (pl)'. What is of interest in this paper is to understand how the various irregular plural forms accommodate to the loss of a plural marker. We will show that two competing forces contribute to the implementation of plural marker loss: gestural reduction in a prosodically weak position and analogy. We claim that gestural reduction and analogical forces combine in order to promote the stabilization of the morphological loss of plural markers in noun and adjectives in BP. Within a complex adaptive system perspective view our findings may be understood as variable trajectories which configure the morphological loss of plural markers in noun and adjectives. Thus, several apparently independent sound changes involving the loss of a plural marker in BP (Groups 2 to 5) operate with the general purpose of reassessing ways of marking plurals in nouns and adjectives. Thus, sound change may operate through various trajectories in order to consolidate grammatical patterns which in the case under investigation, is the loss of plural forms.

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Allophony as a response to lexical competition: Allophony correlates with high functional load of the conditioning context.

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Functionalist approaches to sound change attribute a role to low-level, universal phonetic biases as significant drivers of sound change (e.g. Blevins 2004, Beddor 2009). However, following a long line of theoretical and case-based work (e.g., Gillieron 1918, Trubetzkoy 1939, Hockett 1967, Surendran & Niyogi 2006, Silverman 2010), Wedel et al. (2013a, b) have recently provided statistical evidence that the functional load of phonological distinctions can also influence long-term sound change. As predicted by these findings, we provide evidence here that conditioned allophonic variation is correlated with high average functional load of the conditioning context.

Given a phoneme with conditioned allophones, if we know the conditioning context, we know the form of the allophone. Conversely, if we know the form of the allophone we also gain information about the conditioning context. If phonological systems evolve in part to enhance cues to portions of the speech signal that contribute more, on average, to disambiguating meanings in usage (e.g., Piantadosi 2011, Cohen-Priva 2012, Wedel 2012, Hume et al (in press)), then we predict that an allophonic split may be more likely to develop when the phonological structure underlying the conditioning context has a higher functional load, because the allophonic distinction provides redundant cues to the contrast in the conditioning context.

The results reported in Wedel 2013 a,b show that the number of minimal pairs distinguished by a phonemic contrast is an empirically predictive measure of merger probability for that contrast. Extending the database developed by Wedel et al. (2013b), we use this approach to ask whether the phonemic contrasts across the conditioning contexts for allophonic patterns in five languages have a significantly higher number of minimal pairs relative to the complement of the conditioning context. As an example, the palatal fricative in German /ç/ has two allophones [ç] and [x] which are conditioned by the backness of a preceding vowel. For each possible vowel-vowel pair in German, we count the number of minimal pairs that include /ç/ after the vowel, e.g., *riechen* [ʀiçən] ~ *rauchen* [ʀaʊxən], and record whether these vowels are across the conditioning context (e.g., the front-back pair /i ~ aʊ/) or not (e.g., the front-front pair /i ~ e/). Based on the argument above, we ask whether the front-back distinction in German vowels in this context has a relatively high functional load as measured by minimal pair count. The independent predictor for each vowel pair in German is the number of minimal pairs distinguished in the context of a following /ç/, and the dependent measure is whether the vowel pair is *across* the conditioning context (i.e., front-back), or is *within* the conditioning context (i.e., front-front, or back-back). We report here that within this dataset, the distribution of minimal pair counts is significantly higher for contrasts that are across conditioning contexts, than those that are within the conditioning context. These results are consistent with a process in language change that promotes development of redundant cues to distinctions within the speech signal with a high average functional load.

The indexical function of pre- and post-aspiration in a sound change in progress

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It has been shown that listeners use fine-phonetic detail to classify speakers according to social variables such as gender (Foulkes et al. 2011) or perceived sexual orientation (Mack & Munson 2012). The aim of this paper is to assess how listeners draw upon fine-phonetic detail in a sound change in progress to recognize speaker age and speaker's geographic origin, i.e. if they are (explicitly or implicitly) aware of the sound change.

The so called /s/-aspiration (e.g. *cantas* [ˈkantah]) is a widespread and well-studied phenomenon in Spanish. In varieties with /s/-aspiration, syllable final /s/ in words such as *estado* is generally said to be realized as [h] preceding the stop closure (pre-aspiration; e.g. [ehˈtaðo]) or as closure lengthening (e.g. [eˈtːaðo]). For Andalusian Spanish, phonetic studies suggest that in Eastern varieties, /s/ + voiceless stops are produced with pre-aspiration (Gerfen 2002), and in Western varieties, with post-aspiration (e.g. [eˈtʰaðo]; Parrell 2012, Torreira 2012). In an apparent-time study (Ruch & Harrington 2014) with 24 speakers from an Eastern (Granada Spanish) and 24 speakers from a Western Andalusian variety (Seville Spanish), older and younger speakers differed significantly in the production of /st/ with respect to voice termination time (VTT, i.e. pre-aspiration) and voice onset time (VOT, i.e. post-aspiration). The results suggest that a sound change in progress from pre- to post-aspiration is taking place not only in Seville, but also in Granada Spanish.

By means of a perception experiment we tested if pre- and post-aspiration transmit the social categories age and geographic origin of the speaker. We manipulated 18 isolated words from 17 speakers out of the above mentioned production data to get two variants of each token that differed only in the presence of pre- or post-aspiration (i.e. *estado* [ehˈtaðo], [eˈthaðo]). These 36 stimuli were embedded in a randomized order together with 19 filler pairs coming from 19 other Andalusian speakers (e.g. *montón – montón*) in an online perception experiment. Subjects were asked to listen to the stimuli and to judge on a gradual scale the origin (Granada vs. Seville) and the age (young vs. old) of the speaker. 28 hearers from Seville and 22 from Granada participated in the experiment. The same speaker was rated as younger and as more Sevillian-sounding in the stimuli with post-aspiration. A mixed model with stimulus type (pre- vs. post-aspirated) and listener's origin as fixed factors and listener, word and speaker as random factors showed a significant effect of stimulus type ($p < 0.001$), but not of listener's origin on the response. The results suggest that Eastern and Western Andalusian listeners are to some extent aware of the age- and variety-dependent variation in /s/ + voiceless stop sequences. Further analysis revealed a relationship between perceived speaker origin and perceived speaker age for the post-aspirated ($p < 0.001$), but not for the pre-aspirated stimuli. These results mirror the findings of the production study, i.e. that the sound change from pre- to post-aspiration is more advanced in Western than in Eastern Andalusian Spanish.

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Phonetic precursors and structural typology

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The natural-language typological frequency of a phonological pattern is affected by both its phonetic substance and its abstract logical structure. Laboratory studies of the learning of artificial phonological patterns has repeatedly found strong effects of pattern structure beside weak or absent effects of pattern substance (Moreton & Pater 2012ab). That finding suggests a tidy division of labor in the shaping of phonological typology, in which structural and substantive typology are due respectively to inductive and channel bias. This talk will present typological and phonetic evidence that the situation is more complicated, in that structural typology can also be influenced by channel bias.

Specifically, in phonotactic learning experiments, exclusive-or patterns ("either [+F] or [+G], but not both") are harder to learn than family-resemblance patterns ("at least two of [+F], [+G], or [+H]"). However, the available quantitative evidence (based on Mielke 2008's P-Base) suggests that in natural-language phonology, the exclusive-or patterns are more frequent relative to chance, even when agreement and disagreement patterns are excluded. Can that be explained by channel bias? I.e., do phonetic variables tend to covary in ways more analogous to exclusive-or than to family resemblance? This question will be discussed with reference to the interaction between vowel height, consonant voicing, and consonant continuancy in the phonetic precursor of the Canadian Raising/Southern Glide Weakening family of alternations in English around the world.

(Non-) Phonologization : Individual Variation in an Artificial Grammar Learning Task

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Given the inconsistencies in grammatical patterns that can arise over time, regularization of learner input is taken to be necessary for phonetic sound changes to become fully phonologized (see Blevins 2004). This paper tests various hypotheses about this regularization via artificial grammar learning experiments in which participants are trained with auditory stimuli that provide partial evidence of a morphological alternation (cf. Wilson 2003). Depending on condition, there is a single morpheme suffix, multiple unambiguous allomorphs, or multiple allomorphs which *could be* reflexes of the same underlying form. These experiments are designed to test a model of the emergence of phonological epenthesis, either from a historical deletion process, or from coarticulation between two adjacent vowels (see Morley 2012).

Previous results show that participants overwhelmingly choose a phonetic over a phonological interpretation when their input is ambiguous. A phonemic – and, by extension, an epenthesis– analysis is only likely with biasing context (Morley 2011). However, it appears that certain individuals are much more likely than others to adopt a phonemic interpretation of an ambiguous token. Another individual difference emerges in the likelihood to 'boost' (or generalize). Irregularities and multiple variants in training decreased the likelihood of boosting – on average, and individually. However, the relative number of 'boosters' was significantly larger for conditions in which one trained allomorph was several times as frequent as the others, even though there was little averaged effect on boosting (see Hudson Kam & Newport (2005)).

These individual differences provide a way for unlikely (on average) phonologization routes to arise: in the case where 'phonemicizers' and 'boosters' are also innovators, acting to spread a change to the rest of the population (cf. Milroy & Milroy (1985)). Additionally, certain participants can be categorized as producing a pattern that *could* become epenthetic over time. These are individuals who are more likely to maintain distinct allomorphs for distinct types (back-vowel final roots, front-vowel final roots, consonant-final roots). Successive incremental changes over their productions could provide a secondary route to phonologization (cf. Kirby 2007).

Much more work remains to be done in order to establish a model of a continuous route from phonetic variation to phonological process. There are some interesting suggestions from the current work, however. Although most participants collapsed the front-vowel/back-vowel type distinction to a certain extent, they didn't collapse it completely. And while the vowel/consonant distinction was not completely maintained, it was collapsed less still. In particular, when the data held out from training were the front-vowel final roots, the allomorph produced at test was much more likely to be the one participants had heard paired with the back-vowel final roots in training. When the held out data were the consonant-final roots, on average, participants divided their responses between the two allomorphs heard during training. However, even when those allomorphs were heard equally often, there were a significant number of participants who boosted one or the other – reflecting an apparent bias for associating a given type with a single morpheme.

Learning biases in phonological typology

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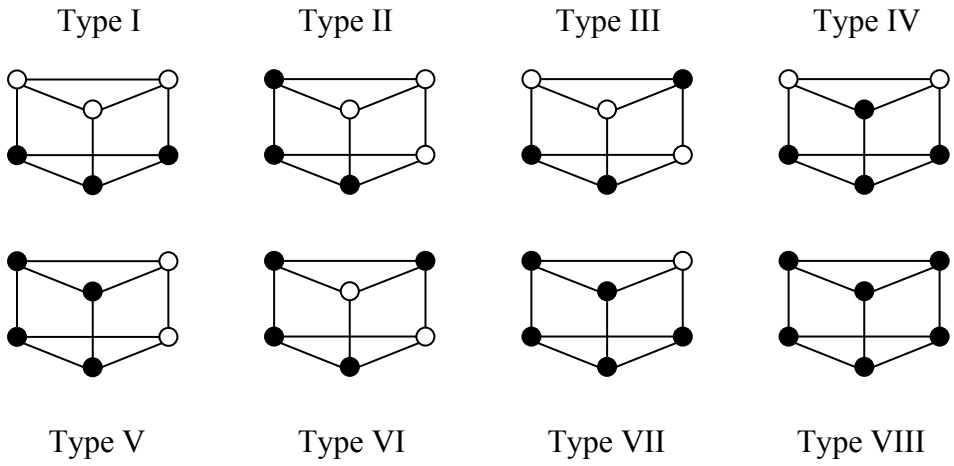
Striking patterns can be observed in the phoneme inventories of the world's languages: for instance, a language that has /g/ is very likely to have /b/ as well. Such observations are often ascribed to feature economy, i.e. a tendency for languages to maximally combine their phonological features. Feature economy may be explained by limitations on human learning, but experiments with non-linguistic stimuli suggest a major role of Boolean complexity (or logical incompressibility) in ease of learning: participants are better at memorizing and classifying more compressible data sets.

I will present a paradigm that aims to experimentally investigate the role of learning biases in the typology of sound systems. These experiments use sign language as stimuli rather than spoken language, in order to avoid any interference of extant phonological knowledge, but the stimulus set is inspired on cross-linguistically frequent plosive systems: every sign can be described in terms of a ternary handshape contrast and a binary thumb opposition contrast (in analogy with place and voice contrasts in spoken language, respectively). The paradigm comprises eight types of inventories, containing 3, 4, 5 or 6 phonemes.



These types display different degrees of feature economy and Boolean complexity, but the two measures are not directly related: for instance, Types IV and VI are equally economical but not equally compressible, and Types II and IV are equally compressible but not equally economical. On the basis of pilot data, I will assess which measure is a better predictor of learning success.

Crucially, the experimental paradigm also contains an iterated learning component, mimicking cross-generational language transfer: one learner's output serves as input to the next. This strategy provides a tool to monitor the evolution of the eight types, and assess whether the systems become more economical/compressible over time. If the final results of the experiments comply with real language data, we may conclude that learning biases play a large role in phonological typology.

Actuation without production bias

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Summary. Computational models of sound change generally appeal to two types of forces to explain stability and change in sound systems: a categoricity bias (CB) which keeps separate phonetic categories stable, and an external force, such as a production bias, which induces change (e.g. Pierrehumbert, 2001; Wedel, 2006). Recently, Kirby and Sonderegger (2013) have shown that both stability and change can be accounted for in a model including both forces, depending on their relative strengths. This paper generalizes this account of actuation to two other cases where change can occur without production bias: contact between two subpopulations, and phonetic variants with different prestige.

Background. We build on the results of Kirby and Sonderegger (2013), who modeled the phonologization of coarticulation in a population setting. They demonstrated that learners with a strong (perceptual) CB, encoded as a prior on the learned degree of coarticulation, can maintain their production systems in the face of weak production bias, but the population rapidly converges to the coarticulated variant once the bias is shifted past a critical threshold. While still working in a population setting, this paper asks if both stability and change are possible without such a production bias.

Experiments. We first considered a case where learners belong to one of two subpopulations with different mean degrees of coarticulation, and varied the amount of interaction between groups along with the strength of the prior. For weak priors, intermediate states become possible, but for stronger priors, both groups can remain stable even when there is some interaction between them. However, even with a strong prior, obtaining just 5% of training examples from a different group can be enough to induce the entire population to converge to a single group's mean.

We also considered the case of a single population in which coarticulated variants have greater social value ("prestige"), operationalized as greater weight in the likelihood function. Here, there is no bias to produce overly coarticulated variants, but when such variants are produced, learners weight them more heavily. While it is not the case that any such weighting will necessarily disrupt stability, here too we observe a trade-off with CB strength.

Conclusions. Phonetic systems can remain stable under a variety of perturbations, such as lenition, contact, and social prestige, depending on the relative magnitudes of the CB and the perturbation. These results suggest a more unified account of the mechanics of actuation, with the crucial factor being the relative magnitude, rather than the specific source, of the displacement event.

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Modelling sound change in relation to time-depth and geography: a case study on the Indo-European and Tupían language families

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Current computational methods offer new possibilities of measuring language diversity and change. However, the results are dependent on data input, probably more than the method of analysis itself. The current lecture will focus on differences in outcome depending on data modelled: sound change, basic vocabulary and typology.

Our approach of modelling sound change is based on the traditional notion of **critical innovations** (common innovations, cf. Josephson 2014) and **relative chronologies** as a basis for identification. Results are then being compared to geographic spread and time-depth, using a model of combining of geographical software (ArcGIS) and computational cladistics tools (MrBayes, R).

Data are being used from two typologically and geographically distant language families: Indo-European and Tupí. These families are very different in terms of historical attestation of sound change.

For Indo-European, we have created a **space-time matrix** (based on the theoretical model of Meid 1975), indicating the attestation of Indo-European languages from 2500 BC to 2000 AD, divided into 250-year-periods. For each of these periods, the languages are connected to geographical coordinates (Carling et al 2014).

The sound change data sets are based on the occurrence of critical/common innovations of language states as attested in the space-time matrix (which also includes reconstructed states, e.g., Proto-Germanic, Proto-Celtic). In the sound change sets, changes are rated on the basis of their impact on language change. Analysis of the data sets is performed by means of MrBayes (clado/dendrograms, unrooted trees) and R (biplots).

Results are then being contrasted, on a three-dimensional axis, against time-depth and geographical distance from a calibrated mass center. Subgrouping and embeddedness of the cladistic tree is also displayed geographically by using the ArcGIS software.

For Tupí, no detailed space-time matrix is created. Languages are marked geographically on a one-dimensional scale, showing the current spread of the languages. As with Indo-European, sound change data sets are based on critical/common innovations, taking into consideration the proto-states (i.e., branches) of the family (Rodriguez & Cabral 2012).

Preliminary results show that the difference between the outcome of trees / biplots is different depending on data type: sound change trees/plots, basic vocabulary trees/plots and typological trees/plots come out differently, and the tendency is stronger within the Tupí language family than with Indo-European. The tendency is also reinforced when the geographic spread and time-depth is taken into consideration.

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A computer simulation of Franconian tonogenesis

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The lexical tone contrast in present-day Limburgian, Ripuaric and Moselle Franconian arose from a process of lengthening of vowels in open syllables (around the 11th century), by which e.g. an original length contrast, as in mølən ‘mill’ ~ vøølən ‘feel’, turned into an accent alignment contrast, as in møølən ~ vøølən (Boersma 2002/to appear). The lexical and morphological contrast was later enhanced by the drop of final schwa (from non-contrastive vállə ‘trap’ ~ váĺ ‘fall’ to contrastive vál ~ váĺ, and from non-contrastive stɛ́ín ‘stone’ ~ stɛ́ínə ‘stones’ to contrastive stɛ́ín ~ stɛ́in), by the deletion of intervocalic ð (wɛ́ɛ́kən ‘weeks’ ~ prɛ́ɛ́ðəkən ‘preach’ → wɛ́ɛ́kən ~ prɛ́ɛkən), and by various morphologizations and other analogies. Gradually as well, the accent alignment contrast turned into a tone contrast, with for instance the 12 tonal contours described by Gussenhoven (2000) for Roermond, which depend on the lexical tone, on the position in the sentence, on whether the word stands in focus position, and on the intonation type of the sentence.

In this talk I show by computer simulations how the present-day situation could have arisen over the course of a thousand years. The crucial assumption is that we need to take into account **three levels of representation**, namely underlying form (UF), phonological surface form (SF), and (auditory-)phonetic form (PF). At various diachronic stages, the UF of the word contains either a syllable-based accent, or a mora-based accent, or an accent marked for tone, and the UF of intonation contains varying tonal material. At every stage, SF contains moras, mora-linked tones, and segmental information such as feature values for voicing and sonorancy. PF contains pitches, durations, periodicity and spectral information. UF and SF are connected by faithfulness constraints, which perform phonological production as well as word recognition; SF and PF are connected by cue constraints, which perform phonetic implementation as well as phonetic–phonological perception. In production, the UF→SF mapping is evaluated in parallel with the SF→PF mapping, and in comprehension, the PF→SF mapping is evaluated in parallel with the SF→UF mapping.

The computer simulation runs by having a number of virtual adult speakers talk 11th-century Franconian to a number of 11th-century virtual children, who also talk to each other. On the basis of their phonetic input and the meaning of the sentences, the children construct phonological surface representations, underlying lexical forms, and the grammar that relates the three levels of representation. We then let the children virtually grow up, spawn new virtual children, and speak to these. This goes on for a number of generations.

With this computational model, the facts of the Roermond tone system follow “almost automatically”; that is, there exist sets of plausible settings for the numerical parameters that will turn 11th-century Franconian into present-day Roermond Limburgian.

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